# unasylva

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vol.27 no.108

## wood-based panels

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T.M. Pasca, editor
Forestry Department, FAO


Cover: Wood-based panels, a small sample of their unlimited variety (Design by Dino Rigolo, FAO)


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# The age of engineered wood

It is possible to radically alter and control the properties of man's most important renewable resources for construction. As metals and plastics replaced wood in the past, wood may now replace these materials on the basis of improved performance as well as cost and availability. This article was originally presented as the keynote address to the World Consultation on Wood-based Panels held in New Delhi in February 1975.

**G.G. Marra**

Materials engineering is a term now gaining widespread use in connexion with all activities related to the control of properties of materials. Hence, materials engineering implies a synthesis of various basic elements and a knowledge of processing variables, which together control the properties of all man-made materials.

The key word in this definition is "synthesis." Its special power lies in its potential for yielding a wide range of materials whose properties may be tuned individually to predetermined use requirements. Process control also leads to greater uniformity and reliability in the material. Typical materials of great value in the world's economy whose properties are thus controlled include all metals, plastics, ceramics, and many others.

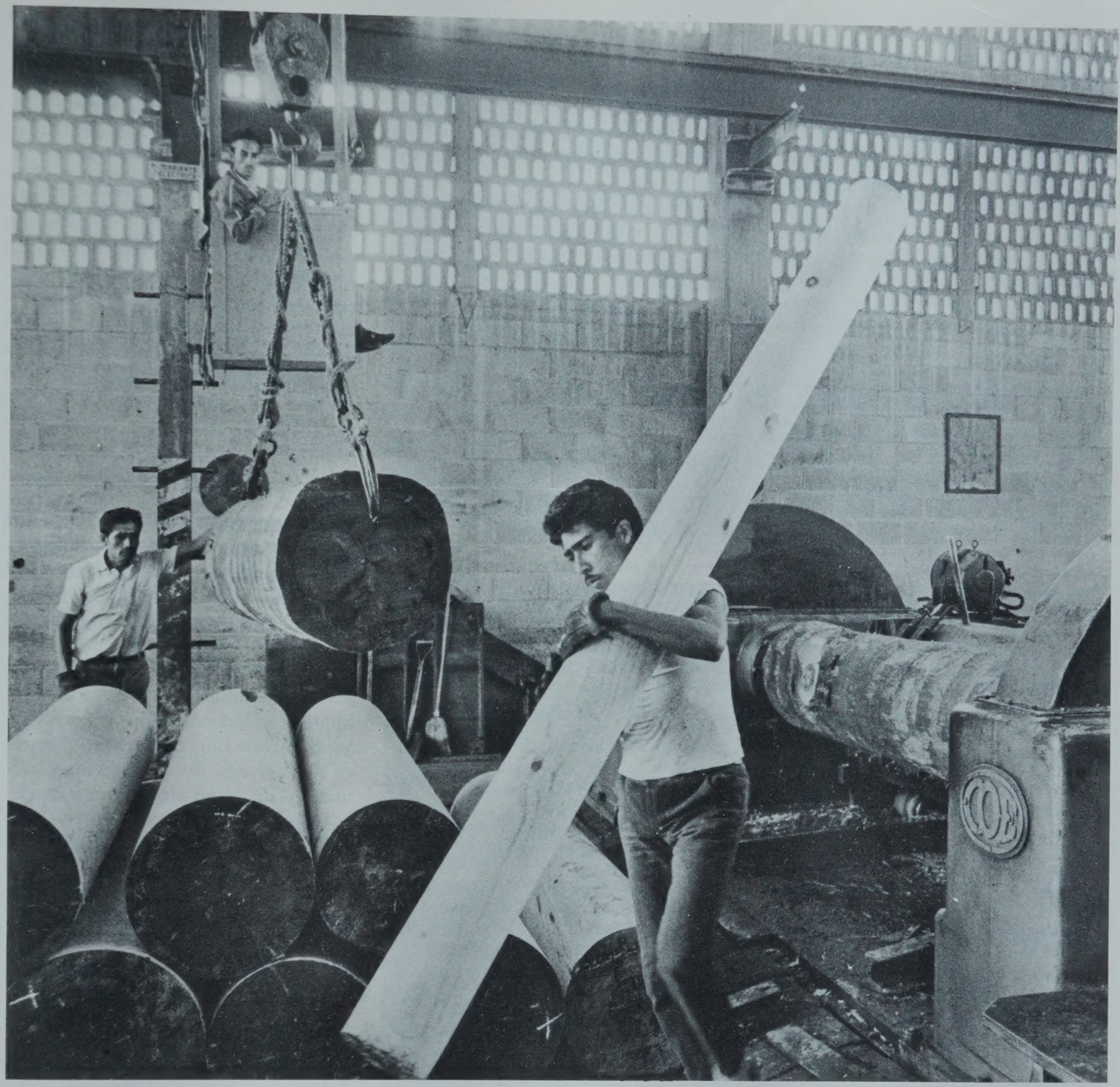
G.G. Marra *is Assistant Dean for Research, College of Engineering, Washington State University, United States.*

### Under control

Wood, as a material produced by the biological processes of nature, has always been assumed to be beyond the control of man in regard to its properties. This assumption is no longer valid and must be challenged vigorously in order for wood to take its rightful place in the family of man-made materials.

There are important imperatives of our times which dictate an early recognition of the special virtues of wood when considered from the standpoint of controllable properties. These imperatives are related to the total world inventory of depletable and nondepletable resources and the projected requirements for the future. Without going into details, it is enough to say that many leading thinkers are calling for some form of conservation in order to ensure the maintenance and/or the attainment of an adequate standard of living for everyone — now and for centuries to come. The simple and direct conclusion from this line of thought is that materials based on renewable resources must carry a larger burden in sustaining the technological aspirations of future generations. In the realm of structural materials this certainly means wood.

There are other strong imperatives that arise from considerations dealing with energy and the environment. Both of these find wood to be highly cooperative. The forest as a manufacturing plant uses solar energy exclusively, and



THE VENEER LATHE SECTION OF A PLYWOOD MILL IN MEXICO

*The variety of wood sandwiches is endless*

later processing of the material consumes only moderate amounts of energy compared to other materials. Furthermore, the forest as a manufacturing plant provides a highly desirable environment; and again, later processing contributes only minor impacts and these are being gradually eliminated through gainful means.

Considering the nature of these imperatives, an appreciation of the synthesis capability of wood comes at a most opportune time in the history of mankind. Not only will wood provide new and improved materials, but it will do so in quantities substantially greater than might otherwise have been possible. It should be remembered that although the forests of the world are renewable in perpetuity, the amount that can be harvested under sustained yield conditions at any one time is finite. Although at present this statement may have more validity in some countries than in others, time drives toward equality in this respect. Hence, it is well to consider that the necessary gains in wood products may have to come largely from within present limits of forest output.

Therefore, the main thrust of the age of wood materials engineering is aimed at the following goals:

— To provide wood materials with improved properties.

— To provide large quantities of wood materials from the forest resource.

If wood is to assume its larger role with dignity and respect, it must first be accepted as a material having a new order of uniformity, reliability and utility. This message must reach beyond the practitioners and disciples of wood, to the highest levels of materials policy formulators, and materials science educators. Such is the purpose and the hope of this paper.

In retrospect, the application of the concept of synthesis to wood is not new. The engineering properties of wood were first subjected to a type of synthesis action, although unknowingly, when lumber was laminated and special attention was given to the selection and placement of various grades of lumber within the member. With the advent of nondestructive testing of lumber, the synthesis concept applied to laminated timber can now yield engineering properties in excess of the average for its individual elements. This result arose from a knowledge of the stress distribution under load conditions, a knowledge of the properties of the wood elements and the adhesive involved, and a knowledge of the processing variables.

TABLE 1. — BASIC WOOD ELEMENTS

| | |
|---|---|
| 1. Logs | 7. Flakes |
| 2. Lumber | 8. Excelsior |
| 3. Thin lumber/thick veneer | 9. Strands |
| 4. Veneer | 10. Particles |
| 5. Long flakes/short veneer | 11. Fibre bundles |
| 6. Chips | 12. Paper fibre |
| | 13. Wood flour |
| | 14. Cellulose |

Basic wood elements arranged from largest to smallest. Of the elements shown, 10 can be produced from residue wood, or material unsuitable for lumber and plywood, and all can contribute to the development of new product concepts. (By permission of the *Forest Products Journal.*)

### The basic wood element

This is the basic essence of synthesis and it contrasts with its application to all other materials in only one respect — the size of the basic element. The basic wood element is quite large compared with the atoms and molecules involved in synthesis operations of other materials. In all other respects, the actions and the results have identical counterparts, including the depth of intellectual activity. Indeed, since virtually all synthesis with wood elements involves adhesives and the molecular forces of adhesion, it is obvious that considerations at the atomic level are a vital part of the action with wood. In addition, diffusion phenomena for heat, liquids and gases are important aspects in understanding the rheology of the system during the

## PLYWOOD GLUE EXTENDERS IN ASIA

### a visitor's view

*At the twenty-eighth annual meeting of the Forest Products Research Society of America in June 1974, Joe E. Robertson, Vice-president of the Robertson Corporation, Brownstown, Indiana, presented a paper based on his observations of the use of plywood glue extenders in Asian plants he visited in 1973. The full report was also published in the November 1974 issue of the Society's publication,* The forest products journal. *The author visited plants in Japan, the Republic of Korea, the Philippines and the Malaysian peninsula. Mr. Robertson's summary and conclusions follow.*

The development of the plywood industry in Asian countries has been very rapid; it is a new industry generally less than 25 years old. The Asian plywood personnel in all countries were most hospitable, cooperative and eager to exchange information about new developments. The plants we visited were large and operated at a high rate of production with many employees and modern and efficient equipment.

One of the largest plywood plants in the world was visited in the Republic of Korea. Here 160 000 four-by-eight panels were produced daily with the aid of 5 500 employees; about half of these were young women.

Most of the Asian production was quarter-inch four-by-eight. Japanese-produced panels were manufactured largely for Japanese markets, while about 70% of the production at the other plants visited was intended for United States markets. Logs were extremely large by United States standards and were mostly of lauan or similar woods. Logs originated in the Philippines, Malaysia and Indonesia.

General extender quality in Asia was found to be inferior to that in the United States. However, a number of reasons contribute to the use of low-grade flours in many of the plants in several countries. For example, government purchasing policies and the existence of subsidies on certain cereal products for determined uses were undoubtedly factors in extender use. Also, effluent limitations are not as prevalent in Asia as in the United States. Glue technology is generally a little more advanced in the United States, where the saving of labour and supervision time is economically more important.

Great interest was expressed by the Asian plywood technicians in extender information, and they indicated that quality improvement in this field will take place as soon as change is practical.

The following conclusions may be drawn:

1. Philippine (Mindanao) extender quality was better than that found at most plants elsewhere in Asia (low-ash, soft-wheat extender being used).
2. Japanese extenders were of lowest quality, but it must be remembered that extender selection here is probably largely influenced by government policy, and that panel production is mainly for domestic consumption (low-grade clears were in general use).
3. Extender selections in the Republic of Korea were associated with the quality of finished panels. The better extenders were used in the glue mixes intended for the higher quality plywood. Quality ranged from high-quality soft-wheat flours to finely ground "feed."
4. Asian quality control programmes are improving, and the writer anticipates a rapid upgrading of general extender quality.
5. The selection of higher quality special extenders will become more widespread as the Asian technicians recognize the contribution of proper, special extenders to resin conservation and the necessity for "no discharge" pollution control.

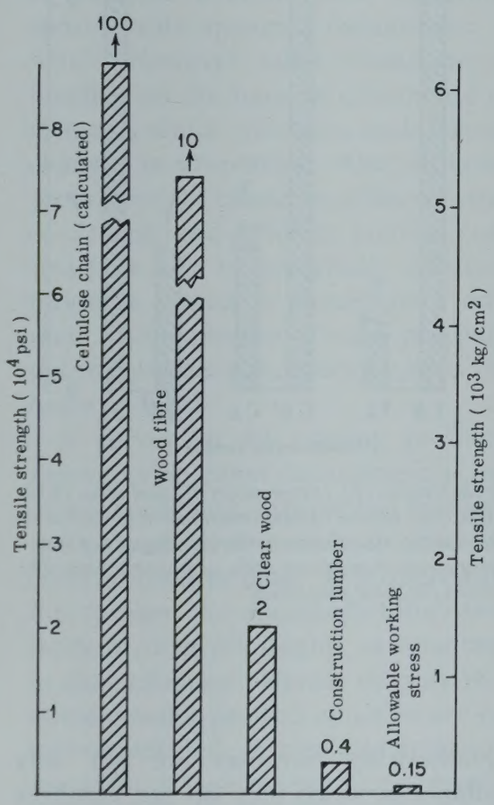
transformation of the material from the loose to the consolidated state.

### Plywood as example

Continuing with the synthesis concept, plywood provides another outstanding example of a wood material produced by deliberate arrangement of the basic element, veneer. The result is an equalization of the properties in the two panel directions, and perhaps more importantly, structural wood in panel form. In the process of synthesis of plywood, one property was improved far beyond nature's best effort, namely, resistance to splitting. Dimensional stability was also greatly improved. Again, a knowledge of the wood element, the adhesive and the processing conditions was necessary to achieve this result — a true synthesis action that was not recognized as such at the time.

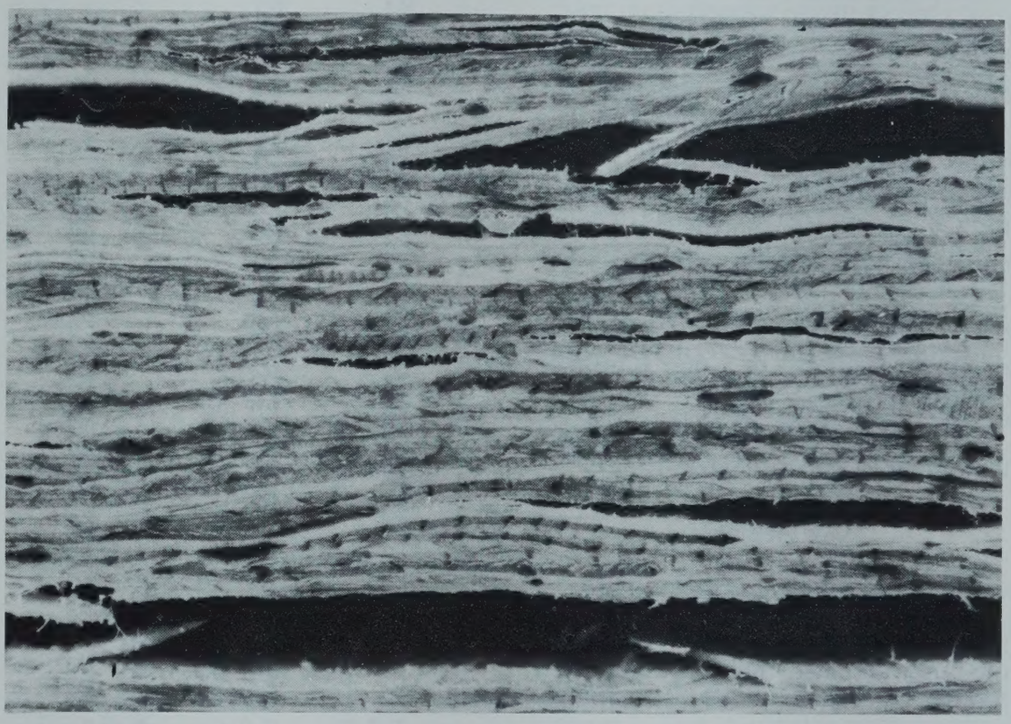
The importance of this matter of synthesis, although somewhat academic, should not be underestimated. The opportunities for synthesis of wood materials are now greater than at any time in history because of the large number of basic wood elements now available. Laboratory studies running the full gamut from fundamental to applied can match the intricacies and scope of those of any other material. The probabilities of such efforts bringing forth many new materials of wide utility are exceedingly good. As will now be shown many of these new materials will come primarily as extensions of the forest resource. Since some of the major gains anticipated for wood will be in its expanded role as a structural material, this paper deals primarily with this aspect of the subject.

**1.** TENSILE STRENGTH




*Comparison of the tensile strength of wood elements, showing a nearly thousandfold depreciation from nature's molecular handiwork to man's rectangular element for engineering construction (Douglas fir).*

**BEFORE**



**AFTER**

**2.** *Edge view of flakeboard before and after moisture stressing, showing large planes of weakness characteristic of this wood element (magnified × 5).*

Lumber and veneer are only two of the basic wood elements now available with which to initiate innovative synthesis activities with wood. Table 1 shows a total of 14 basic wood elements, some of which are fairly recent inventions. Some of these elements are discoveries and some are inventions, but as a group they stand as a solid measure of technical and scientific progress in the field of wood. Doubtless, new elements will be added from time to time.

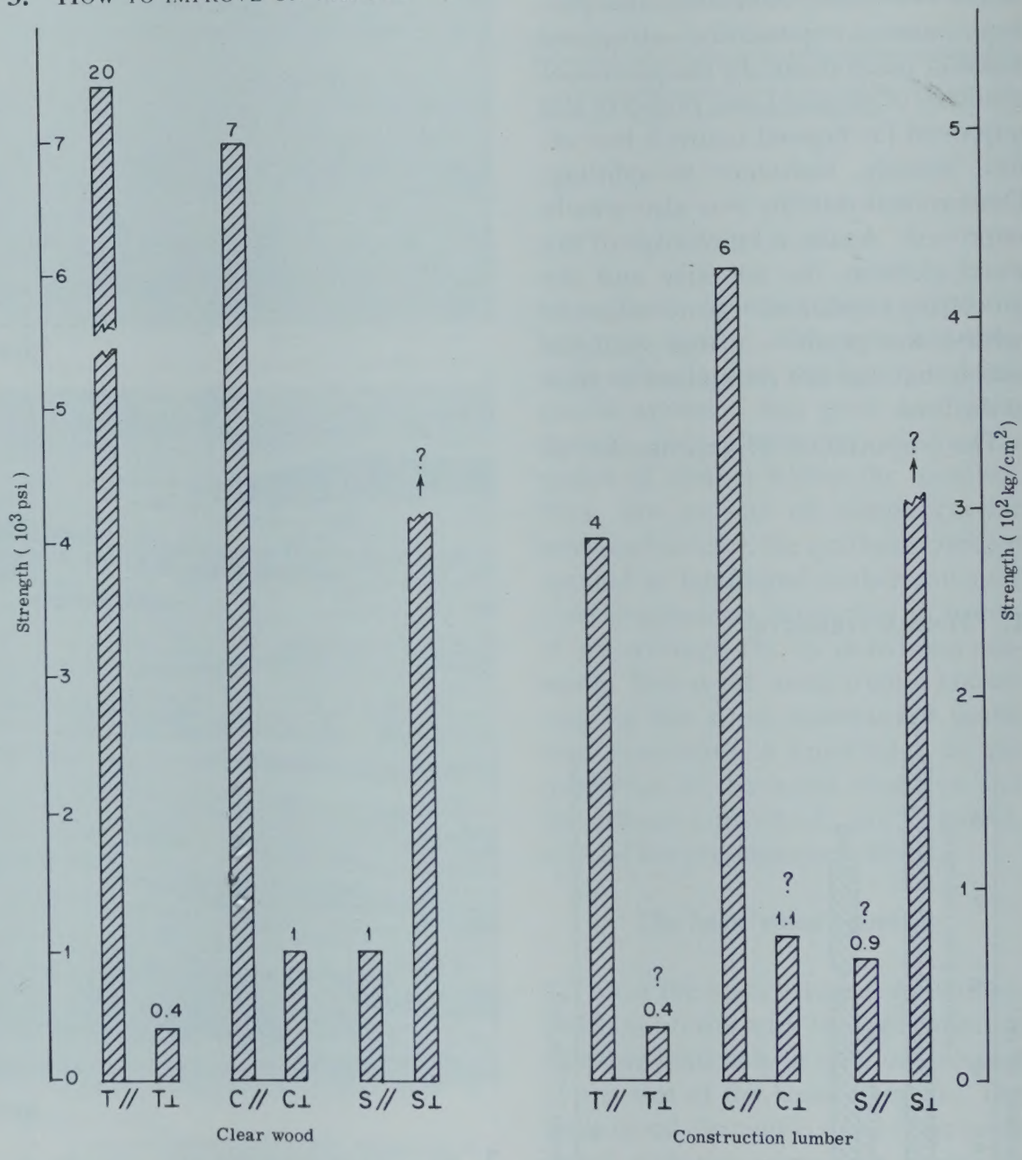
The elements are arranged in decreasing order of size, from logs — or roundwood — the largest, to cellulose, the smallest. Cellulose, although a major component of wood, is actually nonwood in the free state. It is included primarily to complete the predictive power of the table, and to suggest synthesis possibilities with other elements, perhaps in the form of a plastic overlay. Lignin is omitted despite its experimental use as a plastic material, but may soon command joyous attention if future research can establish its potential as an effective, low-cost adhesive. Bark also is omitted, partly because it is nonwood by definition, and partly because current research suggests that it may merit its own table of basic elements for synthesis of a new family of construction materials.

These elements have been described in a previous paper (Marra, 1972).

### New elements

Some elements are recognized as common in the wood industry, others are rare or experimental. In addition to lumber and veneer, flakes, particles and fibres are in major usage. Chips, normally an intermediate element in the generation of other elements, have been used experimentally as an element in their own right. Excelsior acquired element status when it was combined with inorganic binders to produce a board with acoustic and insulating qualities. Wood flour merits a place in the table on the basis of its use in moulded shapes and a surfacing element in other board products. Strands were developed primarily as an orienting element, of which more will be said later. Two somewhat anomalous elements, thin lumber/thick veneer and long flakes/short veneer, offer a potential not yet well expressed. The first seems destined to serve as a laminating element to produce special lumber, while the second may find use in structural panels, either in oriented or random configuration.

**3.** How to improve on nature




*Comparisons of strength properties of wood (Douglas fir) in tension (T), compression (C) and shear (S) in directions parallel (//) and perpendicular (⊥) to grain illustrate nature's finest contribution as well as its major fault. Comparison of clear wood and construction lumber illustrates the further impact of man's manipulation. Note that T// suffers most, while other properties change very little, or possibly gain. The question marks indicate lack of knowledge of specific values for these properties.*

An additional element not shown in the table is one known as "wafers," which are actually very thick flakes. Perhaps they are best described as being a cross between chips and flakes, except that they display an obvious length dimension along the grain. Their primary virtue is that they reduce adhesive usage through reduced surface area and, for the same reason, they minimize reduction energy.

Returning to the table, it is necessary to mention that logs as an element for synthesizing purposes are not very adaptable since they do not combine well either with themselves or with other elements. Pushed to a crude extreme (perhaps not so crude), logs bonded together with bolts provide a coherent and aesthetic lattice in such

applications as railroad trestles. Nevertheless, logs are discounted as an element in this analysis of the concept applied to wood.

The most important factor arising from the table is the potential for combining various elements to produce new materials. The most common combinations, such as plywood, paper and particle board, are now solidly entrenched in our technology.

This potential for new materials can be assessed by assuming that a unique combination of elements is a noteworthy innovative event as soon as it occurs, either experimentally or industrially. These events can be called "product concepts" and one such event can often spawn a galaxy of related products, all based on the same concept.

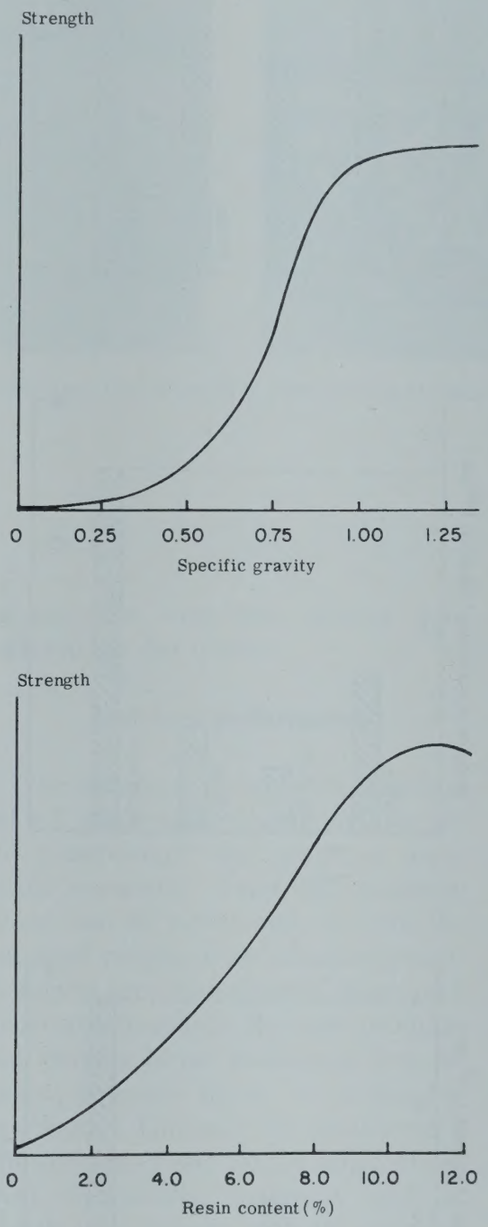
### The possible combinations

Assuming further that these product concepts can arise from combinations of one, two and three elements, then the total number of such events is seen to be mathematically limited. Eliminating logs, and adding three common nonwood elements, metals, plastics and minerals, the total number of possible combinations, including considerable apparent redundancy, is 4 913. However, some redundancy is justified on the basis of orientation of elements which produces such drastic changes in properties. Also different proportions of elements, different sizes of element and different internal construction lead to generically different products. Hence a conservative estimate of the number of valid possibilities for product concepts may lie in the order of 3 000.

A survey of all existing products known to be either in commercial use or in experimental stages has revealed that only about 64 have been discovered or utilized to date. It is interesting that lumber, the mainstay of the wood industry, does not qualify as a concept in this definition. Hence, roughly 98% of the possible product concepts are yet to be developed. Wafers add greatly to the count of possible product concepts, as will any future invention of new basic elements.

It should be noted and emphasized that the majority of these basic elements can be produced from residue wood, or from timber unsuitable for lumber or plywood. Furthermore, the smaller elements suggest an obvious route for recycling wood of virtually any form. It is because of this fact that the second goal of wood materials engineering can be achieved: namely, to provide larger quantities of wood materials from the forest resource. Conservative estimates indicate that a doubling of the material from the forest resource can be realized with wider application of current technology. From this analysis it seems safe to say that the age of wood lies ahead of us, not behind us, and that it rests in the realm of materials engineering in the truest sense of this term. It is an even brighter future than that envisioned by Egon Glesinger some decades ago (Glesinger, 1949).

**4.** TWO IMPORTANT VARIABLES




*The relationship of specific gravity and resin content to strength illustrates two powerful processing variables which must always be specified in the synthesis of wood composition materials.*

The peak engineering properties of wood stem from its highly organized fibrous structure. This structure also produces the anisotropic nature of wood in which peak properties become inextricably associated with exceedingly weak properties. This wide discrepancy in properties in orthogonal directions is the bane of engineers attempting to carry out critical design functions with wood.

Figure 1 shows the peak property tensile strength parallel to the grain, from its molecular origin to the greatly depreciated value with which engineers are forced to work. The species chosen for this discussion is Douglas fir, a choice construction species in the United States. It is interesting that the major loss is above the fibre level, where man's need for long rectangular shapes converts natural characteristics such as knots and cross-grain into natural defects. In addition, variability takes a heavy toll in the statistical calculation of the allowable working stress.

### Particle board

The foregoing strongly suggests that the place to start the application of materials engineering principles to wood is at the level of the fibre and above. This coincides with a critical point in the growth of the particle board industry — a worldwide phenomenon scarcely 30 years old. Like laminated lumber and plywood before it, particle board began as a synthesis operation, again unrecognized as such, but went on to register many technical innovations, improvements and modifications through control of processing variables. A new genus of man-made materials was born and its growth can now be fostered best by systematic application of principles similar to those employed by metallurgists, ceramists and polymer chemists. Major gains can be scored, not only

through synthesis, but also, for example, through studies of fracture mechanics. Such knowledge would be useful both for improving the initial particle-generating operation and for understanding the internal structure of the material (Figure 2).

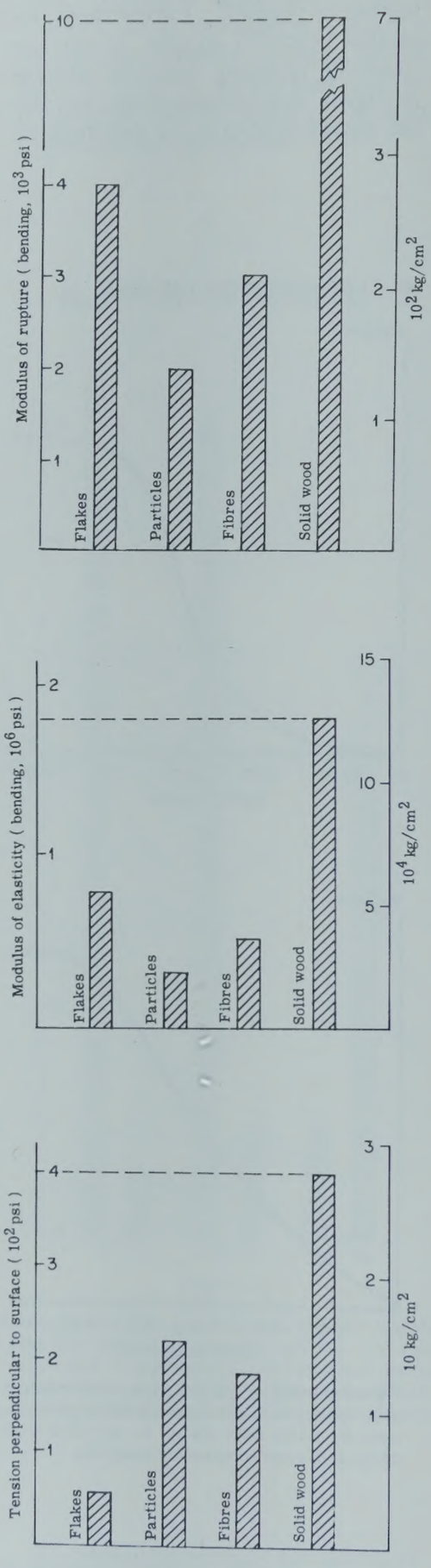
Figure 3 illustrates the anisotropic nature of wood from the standpoint of certain engineering properties. Again, the largest discrepancy is tensile strength between parallel-to-grain and perpendicular-to-grain directions, almost a fiftyfold difference in the case of clear wood of Douglas fir. The defects present in construction lumber produce a drastic reduction in tensile strength parallel to grain, but, despite the lack of accurate data, there are apparently only minor changes in other properties.

### A technical conflict

Although strength is not the only criterion of progress in wood materials engineering, it is immediately evident that a major technical conflict exists in dealing with the organized structure of wood. Two key problems, anisotropy and variability, yield to homogenization of the structure in direct proportion to the size of element. Laminated lumber and veneer, for example, retain anisotropy while gaining a measure of uniformity (i.e., reduced variability). Smaller elements randomly disposed produce two-dimensional isotropy and an even greater degree of uniformity. Knots and cross-grain drop out completely as factors affecting strength. At the fibre level, even species differences begin to fade. The achievement of three-dimensional isotropy remains as an interesting challenge for future materials engineers.

Isotropy and uniformity are technical improvements of great significance, but this gain is achieved at the expense of the peak properties of solid wood. Some strength can be regained through higher resin content, or higher density, or both. As shown in Figure 4, all strength properties are greatly dependent on these two factors. Perhaps the most direct way of restoring strength is through orientation of the elements. Orientation has been under investigation in the United States and Europe for a number of years and has

5. GEOMETRIC POWER




*Comparison of properties of board materials produced from Douglas fir flakes, particles and fibres, showing the power of geometry in influencing the performance of the wood element. The solid wood value represents a goal hopefully to be achieved by future research.*

recently been inaugurated as a commercial process in both continents. It is the most exciting new development in the wood industry since the development of particle board itself.

### Problems of strength

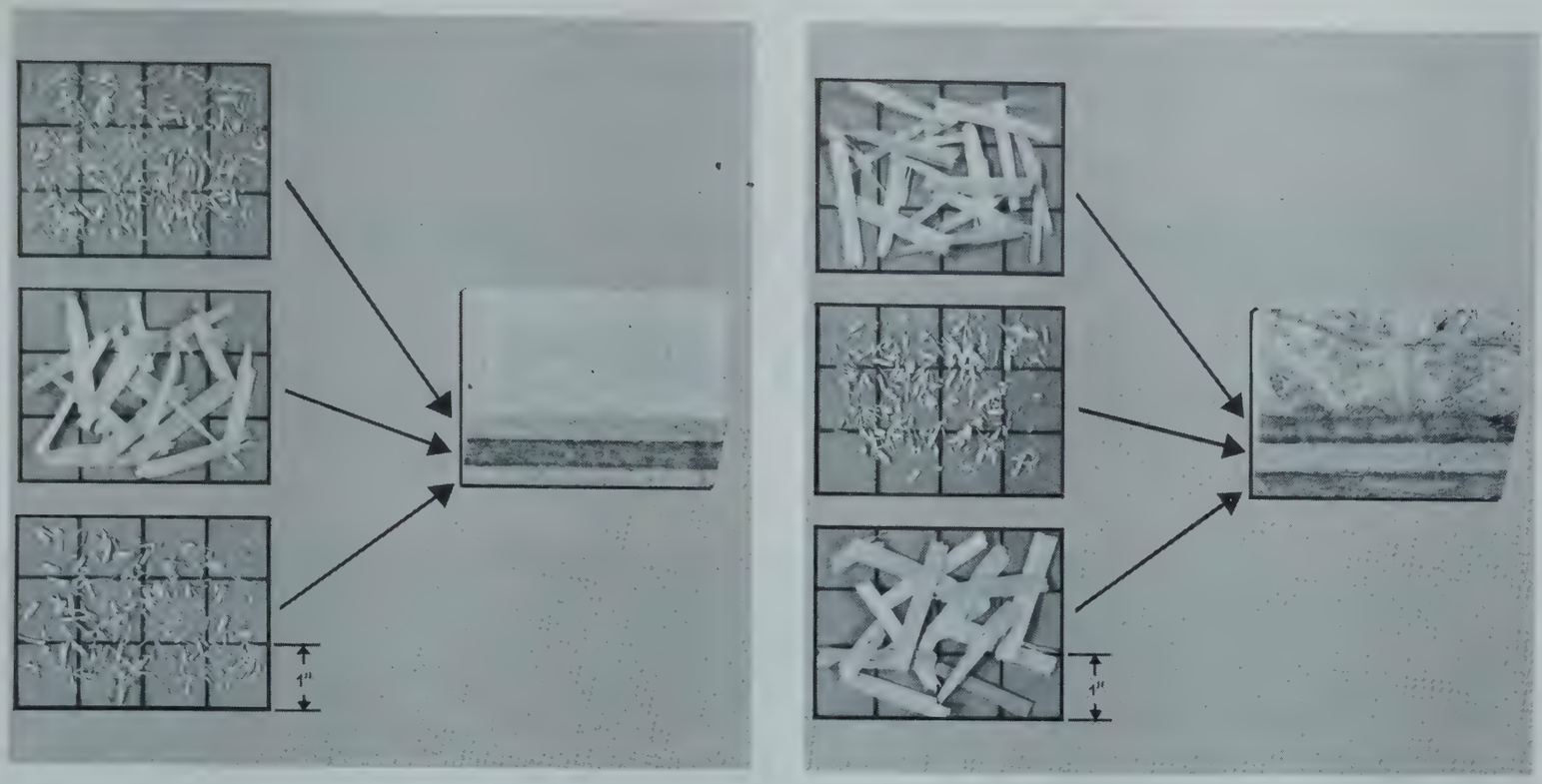
The application of orientation confers strength at little or no cost and it can be controlled to any degree desired. Isotropy is lost, but control of wood variability is retained. Orientation combined with high resin content and high density produce strengths approaching those of solid wood. A continuing objective of wood materials engineering is to find ways of reducing both resin content and density while maintaining high strength.

Materials with high-strength properties can be produced in sheet form to serve as plywood-type panels, or the sheet can be ripped to serve as lumber-type members of practically unlimited length. The fact that this goal can be achieved with wood otherwise unsuitable for the more conventional lumber and plywood materials adds greatly to the technical triumph.

Important refinements in controlling the properties of wood materials come from the geometry of the wood element. Figure 5 shows typical strengths achieved by three elements, flakes, particles and fibres, compared to solid wood of Douglas fir, the strength of which may represent a goal of sorts. For example, flakes produce high modulus of rupture and modulus of elasticity, but low values in tension perpendicular to the surface. Particles, on the other hand, produce high values in tension perpendicular to the surface, but low values in the other two properties. These and other elements combined in layers, as illustrated in Figure 6, provide an effective means of bringing the best feature of each to bear in the same product.

### Ingredients and tools

From the foregoing it is evident that the ingredients and tools for the synthesis of wood materials are now at hand and have, in fact, already been utilized to some degree. It is fortunate indeed that in all areas where some form of synthesis is practised, wood




**6.** *Layering technique illustrated with flakes and particles. Left: particle surfaces, flake core; right: flake surfaces, particle core.*

technologists, engineers and other scientists have been directly involved. They have staffed quality control laboratories and in many respects have served unknowingly as materials engineers. Their work has included the maintenance of product properties and the development of information relative to new raw material sources — a task that becomes ever more important as conventional timber sources become stretched to their limit.

It is evident also that all work to date has served only to expose the tremendous opportunities that lie in the future. More intensive application of synthesis techniques will bring many of these to fruition in time for wood to play a new role in the total materials picture.

It has been shown that materials engineering is a discipline, the principles of which can readily be applied to wood in the development and improvement of new materials of biological origin. The many basic wood elements combined with a host of processing variables provide a wide latitude for the synthesis and study of at least several thousand new product concepts. In some cases, engineering properties will exceed the best that nature provides in the raw timber.

### Improved performance

The technical triumphs thus achieved will place wood among the honoured members of the family of man-made materials. From this position, wood will be better able to fulfil the needs of people in an advancing technological age. As a material based on a renewable resource, the new products will carry a larger burden as they replace materials based on depletable resources. This may be considered a substitution of one for the other. However, historically, materials such as metals and plastics actually replaced wood in many instances, doing so either on the basis of scarcity of wood, or because of certain technical deficiencies of wood. Hence, the return of wood, so to speak, must be on the basis of improved performance — a requirement now technically possible.

Technical triumph notwithstanding, the greatest gain to be achieved by the age of wood materials engineering is neither technical nor intellectual. It will be the new capability provided for reordering the consumption patterns of materials, so as to ensure for future generations an adequate supply of materials derived from depletable resources. Some of these, already in short supply, provide unique properties and serve critical functions in everyone's life. Consider, for example, a world without stainless steel. Wood cannot replace stainless steel, but it can replace other forms of iron where these are being used for purposes for which wood can serve as well.

For this reason, it seems incumbent upon those nations with substantial timber resources to foster accelerated support for programmes based on the new concepts of wood materials engineering. The immediate economic gains will be more than matched by improved living conditions for all future generations — and a new age of wood will have arrived. ■

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# MOVING AWAY FROM LOG EXPORTS

**Benjamin F. Sanvictores**

The big timber-exporting countries of the Pacific are phasing out of log exporting and moving toward the manufacturing of their own wood products. The author describes the problems and implications of this change in the Philippines. He calls for common southeast Asian policies on log exports and urges log-importing areas to move into secondary processing at a time when the traditional log exporters want to make and sell semifinished products.

During the past three decades, extraction of timber from Philippine forests has steadily accelerated with the increasing demand for Philippine logs from Japan and other Asian countries. For more than a decade now the forest products industry has been among the country's top foreign exchange earners, accounting for about 29% of the aggregate export receipts in 1973 and 22% in 1972. Exports of logs were valued at over US$303 million f.o.b. in 1973, and $157 million in 1972. Plywood exports were worth more than $77 million f.o.b. in 1973 and $51 million in 1972. However, although these products remain among the country's top ten earners, the situation during the third quarter of 1974 was bleak because of a significant decline in demand and prices in the world market.

As of 30 June 1973, 338 timber licences were in operation with an allowable cut of 16.9 million cubic metres. There were 421 processing plants with a log requirement of 11.5 million cubic metres, representing 68% of the total allowable cut. These included 370 sawmills (using 69.3% of the actual cut), 18 veneer plants (5.6%) and 31 plywood plants (25.1%). There are only 10 blockboard plants, 1 hardboard plant, 1 particle board plant and 3 pulp and paper mills utilizing wood wastes.

The export of logs has always been the most profitable sector of the Philippine wood industry, which is consequently to this day still largely confined to logging operations. By 1973, only about 33% of the country's timber output was being processed into lumber, veneer, plywood and other products. The rest was exported in the form of raw logs. Most processing plants are underutilized. In 1973 sawmills were operating at about 25% of rated capacity, veneer plants at 84% and plywood plants at 59% (later figures were not available at the time of writing).

The need to redirect the development of the Philippine wood industry has become increasingly apparent in the light of the nation's more serious and pressing problems. The swelling population, for instance, which stood at about 42 million in 1974, is increasing at the rate of about 3% per year — thus intensifying the already serious unemployment problem.

Other problems which concern the industry include the growing need for foreign exchange to support the industrialization and development programme; the need to ensure a continued supply of timber for future generations; the prevention of disastrous floods and droughts.

The government's policy is thus to gradually phase out log exports until it enforces a total ban, starting from 1 January 1976.

**Problems of the wood-based panels industry** — The policy of log export phase out brings into focus the existing problems of the industry and how these are bound to worsen as a result of the projected local processing of the several million cubic metres of logs still being exported.

It must be noted that this policy is part of an overall national economic development plan and therefore government action is the key to its implementation. To start with, the policy is supported by a set of incentives through the Investment Incentives Act (R.A. 5186) and the Export Incentives

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Benjamin F. Sanvictores *is Vice-President of the Philippine Lumber and Plywood Manufacturers' Association. This article was originally presented at the FAO World Consultation on Wood-based Panels held in New Delhi in February 1975.*

# Developing countries are making the transition to wood products manufacturing, and dealing with all the complications involved

A WOOD-BASED PANELS MILL IN THE PHILIPPINES

*Top foreign exchange earners deserve to be treated with respect*

Act (R.A. 6135), as well as monetary and financing policies which favour the wood-processing industry but not the log export industry. Disincentives are also seen in the higher export duties and fees imposed on log exports.

**High cost imported machinery, spare parts, supplies, materials and fuel** — since the energy crisis in 1973 the cost of production has shot up in unheard of proportions. By mid-1974 oil prices had increased five-fold, precipitating a worldwide inflation. Consequently, prices of all manufactured goods also rose sharply.

In the Philippines, except for labour and the wood raw material, all the factors involved in the manufacture of

COST OF PRODUCTION OF WOOD-BASED PANELS, 1974 ESTIMATES

| Components | 5.5-mm plywood | | 19-mm blockboard | |
|---|---|---|---|---|
| | *US$ per cubic metre* | *Percent* | *US$ per cubic metre* | *Percent* |
| Wood | 76.34 | 52.41 | 41.41 | 36.27 |
| Glue and flour | 25.17 | 17.28 | 15.18 | 13.30 |
| Direct labour | 11.11 | 7.63 | 16.93 | 14.83 |
| Overhead | 33.04 | 22.68 | 40.64 | 35.60 |
| Total | 145.66 | 100.00 | 114.16 | 100.00 |

wood-based panels (adhesives, machinery, fuel, etc.) have to be imported at inflationary prices. Furthermore, most wood-processing plants have to generate their own electric power because none is available in the remote areas where the mills are located.

By mid-1974, cost of production was estimated to be about 77% higher than 1973. Recent studies show that (compared to 1973 figures) the cost of wood rose by about 80% in 1974; prices of glue and flour — both imported items — increased by 125%. Labour costs went up 35% and general overhead by 58%. Estimates of average mid-1974 production costs for wood-based panels are shown in the table.

Since inflation in the Philippines and the world over continues unabated, it is expected that these costs will continue to rise.

These facts point to the necessity of intensified wood product research, so that the development of the Philippine wood industry will be less dependent on imported components and machinery.

**Great financing requirements** — To process all the logs still being exported will mean the full utilization and expansion of existing plant capacities.

In addition, it will be necessary to establish new and bigger mills. The wood industry is capital intensive. In 1973 the Philippine government interagency group estimated that the nation's log export phase out programme will require about US$100 million, plus about Phil. $750 million to establish the additional mills needed to process the logs that will not be exported from the beginning of 1976. And although no 1974 estimates were available, it is known that these figures have risen even higher considering world inflationary trends. Increasing interest rates from world financing institutions compound the problem.

Studies are under way on how the government can give financing assistance to the wood-processing industry, making such assistance part of the package of incentives. For a chain of valid reasons, the government realizes that the industry has to be helped financially, especially during times of recession in foreign markets. The principal of these reasons is that the only alternative action of industry would be to cut down or even stop operations, and the economy could ill afford the inevitable laying off of factory workers.

Under a set of guidelines, joint ventures with foreign investors are being encouraged by the government in certain areas of development.

**Low recovery from the forest** — About 30% of the tree, consisting of stumps and branches, is left to rot in the forest because of the prohibitive cost of transport from widely dispersed logging areas to the mill site.

**Low recovery in the mills** — Average yield from logs in plywood mills is about 50%; in sawmills about 60%. This may be attributed to the lower quality of the logs being processed, as the mills are completely dependent on their own logging operations. On the other hand, wood processors in Japan and the Republic of Korea buy logs from several sources and are thus able to specify and get the quality they need.

Lower standards of skilled labour and technology are another important reason for low recovery. Hence, part of the government's policy is an intensive manpower development programme to supply the needs of the industry.

**Nonutilization of wood wastes from mills** — The bulk of the wood wastes from processing mills is burned. Some is used for boiler fuel. In other countries, factory wood wastes find a market in wood chips for pulp mills.

In view of the current oil shortage and high prices, the use of factory wood waste for boiler fuel seems to be indicated in a country that has to import its fuel needs to support industry.

**Problems of marketing** — More than 90% of the Philippines' plywood production is exported. From the 1950s up to the early 1960s the industry showed remarkable and steady growth, due to the great demand of the United States market which absorbed about 97% of the country's total plywood exports.

Since the mid-1960s, however, the Republic of Korea has increased its share in the United States market for imported hardwood plywood, and by 1973 this share represented about 58%. The Philippines' share of this market is now about 15%.

Japan's reduced exports of plywood can be explained by the spectacular rise in its domestic consumption. As a matter of fact, beginning in 1973, Japan has become a big plywood importer.

This unfavourable export situation for the Philippines is due principally to the following factors:

• *High freight rates to both domestic and foreign markets.* Freight costs remain the biggest problem in the marketing of plywood both locally and abroad. Past government policies caused the establishment of small-scale veneer and plywood mills within the timber concession areas all over the archipelago. These resulted in insufficient cargo being loaded in numerous outports with inadequate facilities, causing delays in shipment and raising the cost of freight. This is the principal reason why the Philippines has steadily lost its share in the United States plywood market.

Recent studies show that freight

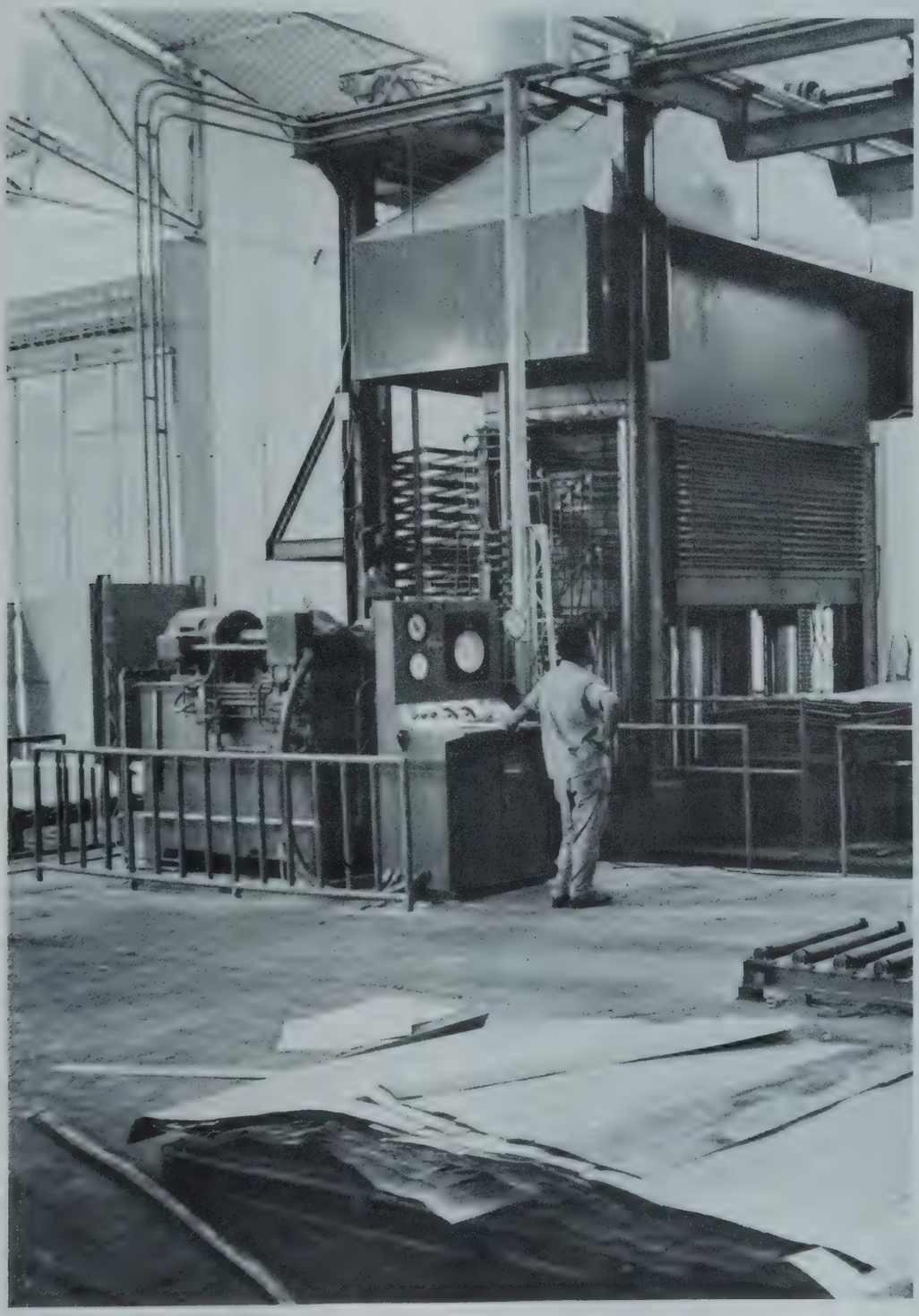
rates from the Philippines to the United States went up by about 44% from February 1973 to February 1974.

Recognizing the advantages of other Asian countries where plywood exports are shipped from only two or three ports, Philippine government economic planners have recently come up with the suggestion that new wood-processing plants be established only where the government has a definite programme for port development.

Government incentives are also aimed at accelerating the expansion of the local shipping industry, so that logs can be more easily and cheaply transported to the mill sites.

During the past few years the freight situation has somewhat improved, due to the practice of transhipment to fewer main ports and the incentives offered by shipping companies for bigger volume shipments and faster loading rates.

Priority is being given to the port development programme so that certain main ports will have adequate facilities for handling wood and other exports.



FEEDING SHEETS INTO A PLYWOOD PRESS

*At times, easier made than sold*

• *Overdependence on the United States market.* The United States is still the principal market for Philippine plywood. In 1968 it took about 97% of the country's total plywood exports. Although this figure went down to 81% in 1973, any slump in the United States market is still felt much more severely in the Philippines than in other plywood-exporting countries that are not as dependent on it. The slump in the world market during the third quarter of 1974 resulted in the slowing down and even the closure of some of the country's plywood factories.

The high cost of construction during these inflationary times, coupled with increased interest rates, has slowed down the construction industries of the United States, Europe and Japan. Consequently, large volumes of plywood and veneer have accumulated in the warehouses, particularly of the big producers awaiting more favourable conditions to dispose of their production, even if only to tide them over the bad times.

In the Philippines, the government is undertaking an intensive low-cost housing and infrastructure development programme, to build up the domestic market for plywood products used in construction and thus alleviate the worsening situation of the wood-based panels industry.

The possibility of establishing barter trade agreements with oil-producing countries and trade relations with centrally planned countries, with which the Philippines has had no trade relationships in the past, is now being seriously considered by government economic planners.

In the light of recent developments, the search for new markets for Philippine wood products is more than ever indicated. Diversification is needed so that the industy will not be dependent on only one product for export. Market research should also reveal which new

A FILIPINO WORKER TRIMS VENEER LOGS
*And keeps a larger slice of wood profits at home*

wood products could be used in importing countries, preferably those that would utilize wood wastes from the mills and the forests.

• *Tariff barriers.* To protect their own plywood industries, developed countries have set up tariff barriers on imports of processed wood products originating from developing countries such as the Philippines. While in 1971 duties on veneer and sawnwood were reduced by 50% in Japan, there has been no reduction of duty on plywood. The United States still imposes an import duty of 20% on Philippines mahogany, although many European countries have reduced tariffs on imported plywood by applying the generalized scheme of preferences toward developing countries.

• *Local government taxes that prejudice the wood export industry.* One factor that has raised the cost of shipping plywood from the Philippines is the export tax on wood and products imposed by the government. When the market was good a premium tax was also levied on the wood export industry. Now that the industry is again in great difficulties, the government is taking a second look at this tax structure.

**Prospects of the Philippine wood-based panels industry** — In spite of the bad export market for timber and timber products in mid-1974, the wood industry can look forward to better times. However, unless the major log-producing countries in southeast Asia — Indonesia, Malaysia and the Philippines — can cooperate and work out a regional policy on log exportation, the development of the wood-processing industry in these countries will be burdened with difficulties and will be very slow indeed.

Already some form of cooperation among the log-producing countries exists. In 1969, technical and economic agreements were concluded between Indonesia and the Philippines. These were renewed in 1974, and two of them have a direct bearing on forestry and forest industries. Through the Association of Southeast Asian Nations, which includes the Philippines, Indonesia, Singapore, Thailand and Malaysia, economic and trade cooperation in the field of timber processing, among others, is now being studied.

Sooner or later the other log-producing countries in the Pacific area will decide to put a total ban on log exportation and ship only processed wood products, even if these products are only in the first stages of manufacturing — such as veneer and plywood. Accordingly, the log importers — Japan and the Republic of Korea, for example — should start to plan on a vertical diversification. They could move toward the "secondary processing" of plywood and wood-based panels, and produce the more sophisticated products requiring higher technology.

To support the country's programme of expansion for the wood-processing industry, and to ensure a continuous and steady supply of the needed raw materials, the government has undertaken intensive and comprehensive studies of forest resources so that log-surplus and log-deficient areas may be definitely identified. Both the government and private sectors are now actively engaged in reforestation projects. Industrial tree-farming ventures are being established jointly with foreign investors.

### The local market

At the time of writing, the prospects for the establishment of plants to manufacture panels utilizing wood wastes is dim. The spiralling costs of the imports required would raise production expenses to prohibitive levels. Furthermore, except for blockboard which is made from low-grade lumber, all other panels utilizing wood wastes (e.g., fibreboard and particle board) are oriented toward the domestic market. Their export is difficult due to high freight charges, and also because developed manufacturing countries produce them from their own factory wastes.

It is therefore necessary to build up the local market for these products, and until the local market can absorb them the only use that can be made of the bulk of factory wastes is for fuel — a measure that can help save the foreign exchange currently used for fuel imports. ■

# RATIONALIZING THE SHIPMENT OF WOOD

**Tore B. Evensen**

The replacement of log exports with wood products processed in developing countries can result in savings, and therefore net profits, for exporters and importers alike; more volume and value can be shipped and these products are easier and cheaper to handle. But rational handling, unitizing and consolidation of cargoes are essential. Even more essential, says the author, is a change in thinking by many of those involved in wood transport by sea.

We live in a world of staggering inflation. We have seen it happen in the lumber industry and in the freight sector, particularly over the past two years. However, we also have a market mechanism which, following a probably unprecedented boom, has worked against the lumber industry. Thus, in the current economic slump the lumber industry is faced with higher freight rates, and even if the situation were to change we know that costs generally go up and that every dollar saved per cubic metre in freight is a net dollar, whether lumber prices are high or low.

We also live in a world of fibre shortage. This is partly due to the physical shortage of wood in the developed countries, but also to a shortage of the men needed to cut and process wood.

### Keeping income at home

The situation is quite different in the developing countries. They usually have both fibres and manpower, and their business outlook should be good. The main question, then, is how can they keep most of their income at home? Since freight costs are so high in the export of lumber products, it is to be hoped that some assistance may be offered them in this field.

LOADING LOGS INTO THE HOLD OF A FREIGHTER BOUND FOR EUROPE

*A picturesque and expensive way to ship wood*

Tore B. Evensen, *the Director of Shipbrokers R.S. Platou, A.S., Oslo, has long experience in the sea transport of wood and wood products, especially from tropical countries to Europe.*

The graph shows the freight costs for various lumber products, based on the official freight conference tariffs from Singapore to Europe. A cost-insurance-freight (c.i.f.) estimate is given for each commodity, the shaded section indicating the share of freight in the total expenditure.

### Degree of processing

The importance of the freight element is evident in the graph. But what is more important is that the more highly processed products carry a lower actual freight cost per cubic metre, and that by ratio of percentage the difference between freight for logs and plywood is 3.25 to 1 per cubic metre related to c.i.f. prices.

The difference is solely due to the degree of processing. Now, this processing can very well be done in most developing countries and it would be much more profitable, if we take into consideration the gain from rational handling and transportation. A vessel is like a factory where the capital and the operating elements are more or less fixed and its cargo is the factor giving the cost element per ton. The lower the output, the higher the cost and vice versa.

The loading of logs ex water or ex quay or barges is a very time-consuming process. Lengths may vary, utilization of the holds is poor and can hardly be improved upon by preplanning of the stowing operation. All these elements result in high freight. That the export of logs should require so much labour in the exporting country itself is bad enough, but what is much worse is that very costly labour is needed at the port of destination in a developed country. Every operation, from the ship's arrival, is extremely labour intensive. It involves handling out of holds on to dock, into storage, out of storage and into transport to the processing mill, as well as handling in the mill.

Shipping logs to developed countries not only means exporting a comparatively low-priced commodity, which is subject to high freights, but also the creating of a need for extra labour in a part of the world where labour is short and costly and which therefore reduces the net profit for the exporter.

Log transport operations bear no resemblance to the handling of plywood or particle board. By importing the latter the developed countries can utilize their own mechanical advantages, i.e., rational, manpower-saving handling methods. Whether we like it or not, we live in a world of competition. To sell a commodity which forces the importer to resort to his costliest element — manpower — is a very wrong policy.

Comparison of shipping costs from most exporting areas is very difficult, because we are up against a jungle of varying rate structures. Figures would be misleading, but some examples may give an indication. Thus, it is interesting to note that the rate applicable for logs ex Rangoon as of October 1974 is $115.80 per 50 cubic feet, equivalent to $81.30 per cubic metre. For veneer in crates the rate is $77.61 per 50 cubic feet, equivalent to $54.81 per cubic metre. In other words, it is nearly 50% more costly to ship logs than it is to ship veneer. Freight costs have risen considerably, and it is unfortunate that because of the lack of data it was not possible to establish how this difference in costs for logs and processed lumber commodities came about. What seems obvious is that the economic yield of logs for export did deteriorate because of freight costs.

### Lumber freighters

A significant transport development in the past four or five years is the chartering of tramp ships for full loads of lumber products only. These vessels run without fixed schedules. Their use is a natural development due to high costs and the shortage of shipping space in regular liners. These services have already yielded some freight savings to the export industry, but even better results could be achieved.

It is encouraging to know that after the introduction of conventional trampers members of the conference found it desirable to compete in this field. The United States and Canada have been using special trampers for many years, for carrying both lumber and wood-based panels. There is no reason why developing countries should not use the same facilities whenever quantities warrant it.

Today, a regular modern liner is a multipurpose ship where the cargo is of the greatest importance. Containerization makes high loading possible. Conference liners have for a long time proved to be the fastest and most regular service for the transport of smaller parcels, but the lumber carrier is the best solution for large quantities. It is specially designed for the various lumber products. However, in order to achieve rational handling right through the transport operation, and save in freight costs, the commodity must be adapted to one or other of these forms of shipping.

### Fighting rising costs

Special ships designed to avoid excessive handling must be built, although the cost of such vessels has now jumped to 300% of what it was in 1960. Fuel prices have gone up about 400% since then and other expenses, such as manning and operation, have risen about 150%. Large units will offset, to some extent, the increase in freights.

Apart from the fact that ships have to be renewed from time to time, soaring handling and other related costs are the main reason why we must adopt rational new units. This is an evolution which cannot be stopped and the sooner the shippers are able to adjust themselves to it, the better the chances for more profitable exports in the future.

The use of old, second-hand low-cost vessels under a national flag to save freight costs is not advisable. These vessels only increase handling, and can cause damage to goods to such an extent that costs would be higher than those of a modern vessel. Whether developing countries should start building new rational ships at fantastic prices is another matter. My contention is that such capital would be much better used in their own lumber industries by modernizing plants and building new capacity, taking advantage of the developments in handling methods taking place in the world today.

A modern vessel able to carry about 80 000 tons of wood-based panels per year from the Singapore area to Europe — a 20 000-tonner — would cost from $16 to $20 million, while building a modern plywood or particle board

factory would call for only $10 to $14 million.

As an example of rationalization, let us take a look at the pulp industry, which for many years used irrational handling methods. A slump which started ten years ago made more rational handling in shipments essential if the industry were to survive. The opening of new and more distant production areas made rationalization even more urgent, for economical marketing. As a result, the pulp industry today enjoys a boom which is in part related to reasonable freight costs.

There is no significant difference between the handling of pulp and of wood-based panels, and a comparison is not out of order. It is also justified because fibre shortage has forced the western world to search overseas for pulp. No doubt the same shortage will force the same customers to go overseas for wood-based panels.

Brazil is at present developing a pulp industry, and worldwide tenders are being asked for ocean transportation from Brazil to Europe and Japan. Tonnage registered in such different areas as Japan, Singapore, Brazil, Europe and the United States are tendering and are fiercely competitive. The freight cost for about 25 000 tons of pulp per shipment from Brazil to Japan as from 1977 will probably end up at less than $40 per ton. This is equivalent to about $27 per cubic metre from Brazil to Japan. The distance between these two countries is 11 500 nautical miles, which is the distance from Singapore to Rotterdam via the Cape of Good Hope. After the reopening of the Suez Canal this distance will be cut to 8 500 nautical miles, or two thirds of the distance. What the Canal's tolls will be is another question.

This significant difference in the transportation costs for pulp and lumber products is the result of the most rational handling, the consolidation of full cargoes and, last but not least, a terminal system at both ends, which allows consolidation at port of loading as well as a unitized handling system at the discharging port, permitting individual distribution to each receiver.

### Fair comparison

Again I would say that comparison is fair, as wood-based panels could well be subject to the same pattern if the right shipping and handling expertise were adopted. By unitizing is meant the shipment of various types of product in separate and compact units. This implies the manufacture of panels in standard sizes.

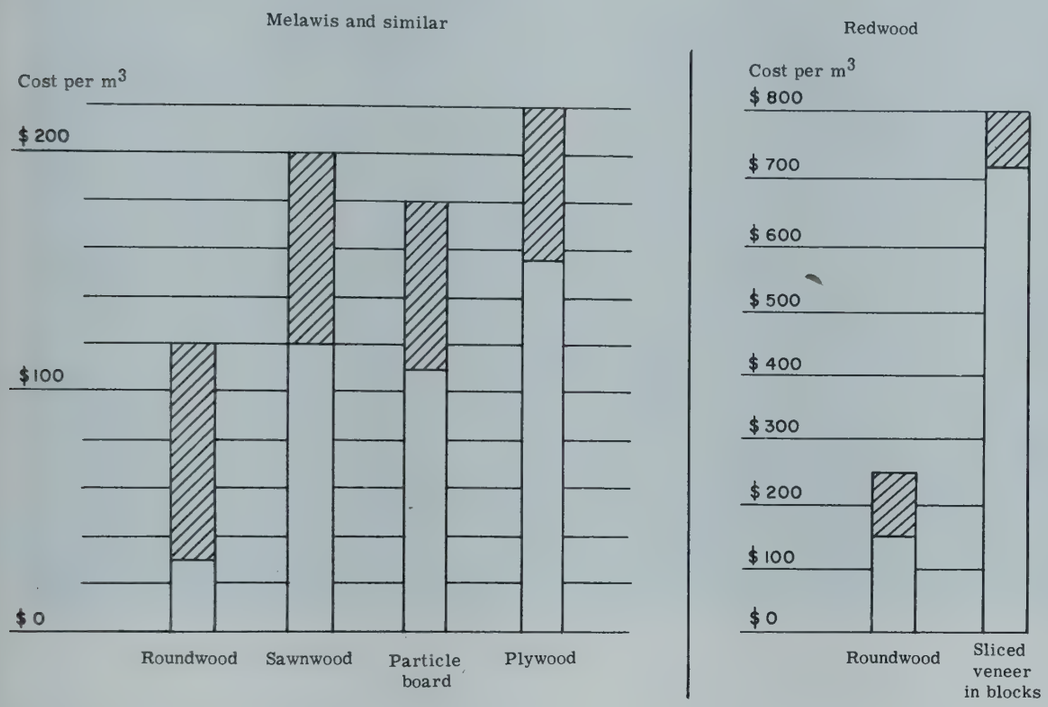
Having been directly involved in this type of planning, I know that by taking into consideration all elements, including production oriented to shipping and vice versa — size of units, handling methods, distribution, and design of vessels — the end result is economically rewarding to everybody concerned. Within the next five to seven years we will probably see close to a million tons of pulp transported from Brazil to Japan. Unless the lumber industry in east Asia knows how to make its own commodity attractive to this transportation system, other exporters will move in and a golden opportunity will be lost.

In any event, shippers should prepare themselves for such a development, which is bound to create competition in the ocean transport sector, and to interest present or future vessels in carrying east Asian lumber at lesser cost than today.

### Conditions vary

Shippers in other areas of the world may not have the same prospects as east Asia for transportation beyond their doorstep. Carrying pulp from Brazil to Japan and returning to Europe with lumber products is a practical example of the utilization of cross trade. Other areas, which may never reach such quantities as east Asia already has today, should market their products in the nearest possible markets to shorten their transport routes. Again, rational handling, unitizing and consolidation is the answer to transportation economy. These principles may be applied to the local liner services for instance, and the shippers may more often than not find an eager liner

## How much of the product cost is freight?




*Hatched lines indicate the proportion of freight costs contained in product costs. First four columns refer to one species which could be exported in four product forms. The two columns on the right are for a species of Asian redwood used mainly for peeler veneer. All figures are approximate and refer to c.i.f. Singapore/Europe in December 1974. (Source: the author).*

AFRICAN MAHOGANY LOGS AWAITING SHIPMENT AT THE IVORY COAST PORT OF ABIDJAN

*Not to be packaged*

service willing to grant rate reductions if their ships can be better utilized.

As an alternative, international shipping expertise should be applied to find cross trades enabling the full utilization of small modern lumber carriers.

### Minibulkers

A fairly substantial fleet of so-called minibulkers is available today to meet such demand. Again, the use of these advanced smaller carriers can only be economical if time in port and the number of ports are brought down to a minimum. The process is the same as for the larger exporting areas, although the savings may not be as substantial. However, even if only a reduction in future costs is assured, this would be a great deal in itself.

What are the remedies needed for redressing the situation?

— Unitization and standardization of the commodities at the mills.

— Consolidation of cargoes between various mills to reach a sufficient quantity for each shipment.

— Concentration of loading to one or at maximum to two ports.

— A port development scheme offering modern deep water berths and huge paved areas to consolidate cargoes.

— Modern technical equipment to handle cargo at loading ports.

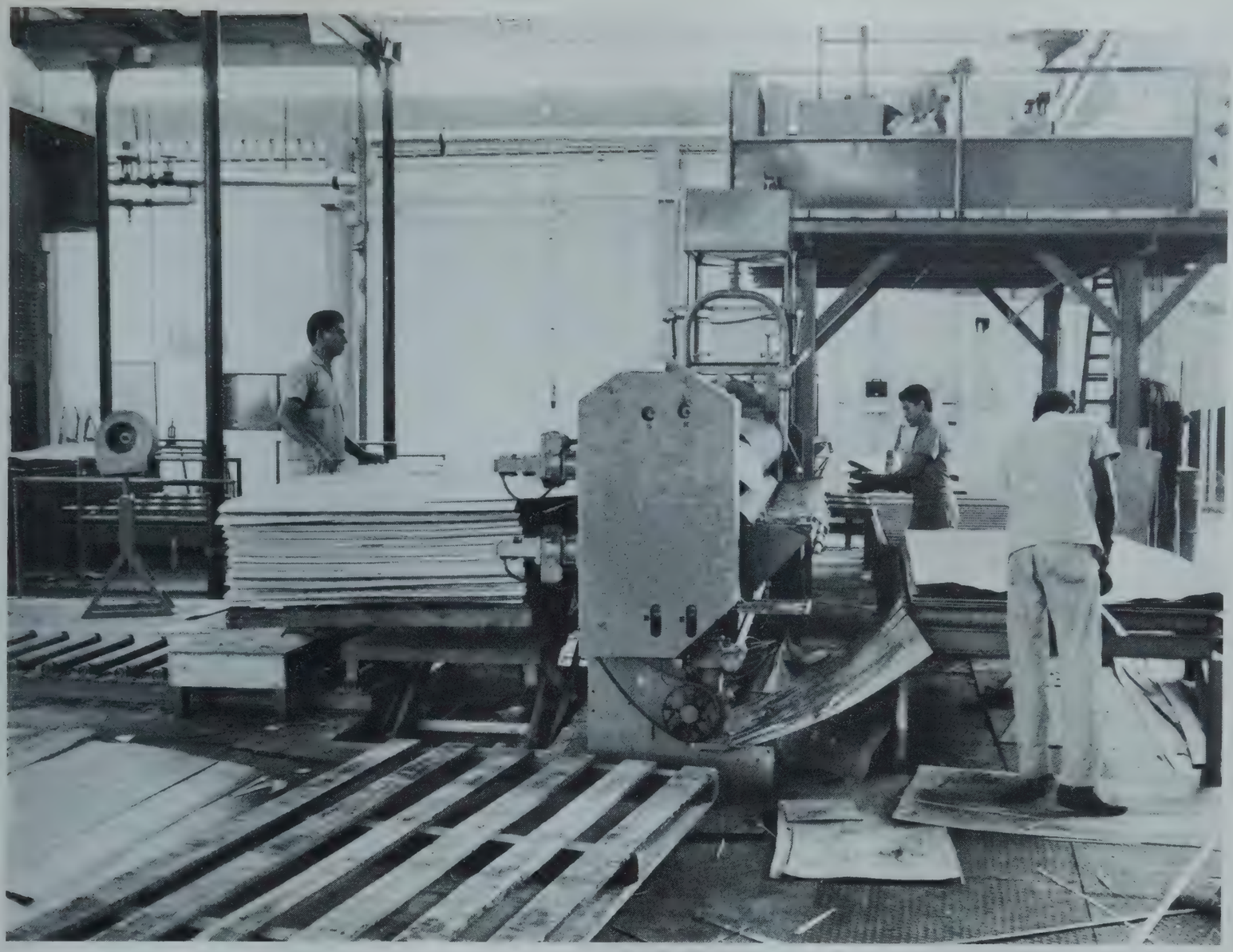
— Cooperation of sales and distribution at points of destination.

As already stated, the ships may be available for this operation. Efficient handling systems are already in operation at the receiving end in Europe. Thus these six points boil down to three — cooperation, administration and port development — and these are mainly the concern of the exporting areas. It may be difficult, but it is possible.

### Costly modernization

It takes effort and capital to modernize or build new mills, reorganize shore transport, reorganize sales and all the many other factors.

It has been done to a great extent in the western world — at the loading ports and, more specifically, in the discharging ports in Europe. There, the



PLYWOOD BEING MANUFACTURED AT A MILL IN COLOMBIA

*Made to be packaged*

traditional exporters have had to invest in both loading and discharging systems. Newcomers in the lumber exporting industry have the advantage of being able to concentrate on their own local problems, because modern technology is ready for them at the unloading end.

Governments and port authorities should give top priority to the development of port areas to promote rational handling. The berths may even exist in some places, but they are often so cramped by old warehouses and so limited by poor paving that they are not really useful.

A decision to allocate an area for this special purpose is often the most severe problem. The authorities need factual knowledge and foresight probably more than they need investments, though I do not mean to underestimate the importance of the latter. A temporary port utilization tax based on private foreign investments until this particular expense is repaid could be the answer. Such a tax would run to only a fraction of the savings in freight.

**The all-important port**

Without a developed port facility other forms of rationalization are a waste. If a port is suitably developed, the tendency is for shippers to follow suit within a very short time, and the immediate outcome will be a higher national income and the growth of local industry.

Large standard size pallets of 20 × 8 feet (6.10 × 2.5 metres), suitable for oven-baked plastic protection, loaded at the mill, will often provide a good answer to many problems and also give protection from damage, one of the many items to take into consideration. Such pallets should be possible to stack by means of supports in each corner.

It is not possible to specify how rational unitizing should be applied, as this will vary according to area and commodity. Sliced veneer will require one shipping method, particle board and plywood another, and readymade processed and lacquered wood strips may require a third.

It costs money to rationalize in this way, but immediate savings will result. The goal seems to me to be worth the task. ■

# FORESTRY IN CHINA

What is the structure of forestry in China? How does China's outlook differ from that of other countries and from traditional approaches? What kind of success and failure has Chinese forestry experienced? How have political and administrative reforms affected forestry? How is the classic land competition between agriculture and forestry dealt with in China? How does China instil forestry consciousness in its people? These are among the questions which the author attempts to answer. He made an extensive tour of forestry in China in 1974.

**Jack Westoby**

It is always difficult to truly understand how a society other than one's own works. A study of the constitution, if there happens to be a written one, does not tell very much. Nor does a chart setting out structural relations, powers and responsibilities. Several important things are always missing. One is how the existing situation evolved from what went on before. Another is modification, sometimes subtle, already under way. More important, no chart explains the differences between what is supposed to happen and what actually happens.

It is the same with forest laws and regulations. Some countries have comprehensive forest laws and regulations. Reading them, one is convinced that these can serve as a model. Yet, when one comes to examine how they work out in practice, one finds that they are so much useless paper. The reasons are many. Often it is a matter of staff: too few staff, undertrained staff, staff so badly underpaid that a livelihood is only possible if bribes are accepted and a blind eye turned to misdemeanours. Sometimes it is the machinery of the law: an overworked judicial system, or courts and tribunals susceptible to political pressures or capable of being suborned. Sometimes the forest law is frustrated by the general uncertainty about land titles.

Yet there are other countries where the forest law — if a special law exists — only makes sense after one has digested 10 or 20 distantly related acts on the statute book. And the regulations which have been issued may be a mish-mash of important matters and seeming irrelevancies. Yet the system works.

In China, forestry activities are still governed by the basic regulations for the protection of forests promulgated by the State Council on 27 May 1963. These regulations, comprising seven chapters and 43 articles, have been amended since then only to take account of certain organizational changes which have occurred; there has been no amendment of substance. Thus, references to the "*people's councils*" of provinces, autonomous regions and municipalities, and to the "*management committees*" of people's communes, are replaced by references to the "*revolutionary committees*" at these several levels. Similarly, the reference to the Ministry of Forests has been replaced by reference to the Ministry of Agriculture and Forests, within which the Ministry of Forests has now been absorbed.

These regulations cover state forests, collectively owned forests, and trees belonging to individual householders. They tell everybody what to do — sometimes in a very general way, sometimes very precisely. For example, Article 3 lays down that:

"Revolutionary committees at the various levels must strengthen propaganda and education in order to promote forest consciousness and forest education, and mobilize the masses to properly protect forests and trees."

Jack Westoby, *British forestry economist, was deputy to the head of the FAO Forestry Department at the time of his retirement as an international civil servant in January 1974. In 1973 Mr. Westoby participated in the discussions which led to China resuming active membership in FAO. Over the years he has written and lectured extensively on forestry development.*

RAFTING TIMBER IN HUNAN PROVINCE

*A forest consciousness which is comparable to that of Scandinavia*

Article 17 relates to grazing in the forest, and says that:

" Livestock grazing near the forests must be strictly supervised to avoid damage to trees. In the forest zones where conditions permit, limited areas may be designated for grazing."

These are fairly general prescriptions, and how far they are carried out, and the way in which they are carried out, will depend largely on the energy and initiative of the particular revolutionary committee concerned. They leave considerable room for local interpretation.

**Administration changed**

By contrast, a sub-clause of Article 12, which deals with felling and transport, provides that any collective unit which fells more than 10 cubic metres of timber in any one year from its own forests to meet its own needs (including the needs of individual members of the unit) must have the authorization of the district revolutionary committee.

But although the basic regulations for forestry in China remain the same today as they were in 1963, the administrative structure through which they are applied has been transformed. This transformation is qualitative rather than formal, for although the political/administrative structure remains more or less intact, the way in which it operates has undergone a number of changes. These can perhaps best be summarized as a far-reaching devolution of responsibilities, coupled with a complete renewal of organs of management.

**Increased autonomy**

The main political units in China remain the 21 provinces, the five autonomous regions, which rank as provinces, and the three autonomous cities (Peking, Shanghai and Tsientsin), which with their surrounding rural areas also have the status of provinces. The degree of autonomy of these main political units seems to have increased, if anything, since the cultural revolution.

The provinces are divided into administrative districts and large cities. The administrative districts are divided into counties, which in turn comprise smaller towns and people's communes. Occasionally there is an intermediate level, the county being divided into districts, each of which groups a number of people's communes. Each people's commune consists of a number of production brigades, and each production brigade of a number of production teams — these last being the basic accounting unit in the

people's communes. In the case of some of the larger communes, with many production brigades, these brigades may be grouped into management districts, which thus constitute an intermediate link in the system.

On the urban side, the cities are divided into urban districts, and these in turn into neighbourhoods, which correspond roughly to brigades in the communes. Under the neighbourhoods are street committees, corresponding to teams. Factories, depending on their size, may come under the leadership of the provinces, districts or counties; within the commune, they may constitute a production brigade or team. Some small collective units (for example, a housewives' group running a workshop) fall under the leadership of the neighbourhoods or even street committees.

### Spreading responsibility

All this remains substantially as it was, save that all down the line there has been a devolution of responsibility. Thus, many large industrial enterprises, formerly directly under the supervision of the appropriate ministry of the central government, are now the responsibility of the provinces, and so on. Broadly speaking, one can say that the responsibilities at the lower levels have increased and their scope for initiative enhanced. This transfer of responsibilities downward has been accompanied by a severe thinning of the administrative ranks at the higher levels, notably in the central ministries, and a corresponding reinforcement of the ranks at the lower levels — where the action is. As we shall see later, this has been accompanied by the transfer to the provinces of many of the central research institutes and higher education institutes.

Parallel with this, in the course of the cultural revolution new organs of management arose at every level, in the shape of revolutionary committees, composed of cadres, representatives of the masses, and members of the People's Liberation Army or local militia. These are now the organs of political power at every level, and in the course of their consolidation efforts have been made to ensure that they fully respond to the two "three-in-one" criteria so often referred to in China: cadres, technicians and masses; old, middle-aged and young.

At each level, the revolutionary committee appoints a standing committee. This is the executive organ of government. Thus, the provincial standing committee receives its mandate from, and reports to, the provincial revolutionary committee. In conducting the work of government, the standing committee is assisted by bureaux established to carry on the administration. These will include bureaux concerned with planning, education, health, trade and so on — and normally one such bureau is the agricultural and forestry bureau. Each of these bureaux maintains contact with, and gives leadership to, its counterparts in the departmental organizations at the next lower level.

### "Leadership" and "control"

As a semantic indication of the kind of devolution of responsibilities and of the de-bureaucratization which has occurred since the cultural revolution, lower level organs are now invariably described as being "under the leadership of" — and never "under the control of" — the immediately higher organs.

This, then, in broad outline, is the administrative structure in China

FOREST WORKERS IN HEILUNGKIANG PROVINCE, CHINA'S MAIN WOOD SOURCE

*Allowable cut should rise to the end of the century*

today.[1] There are many local variants.

At the national level, forestry affairs are dealt with in the Ministry of Agriculture and Forestry, and are conducted under the leadership of one of the seven Vice-Ministers. At the time of writing, this is Liang Chang-Wu, who headed the Chinese delegation to the Seventh World Forestry Congress in 1972. The work is organized in five divisions, namely:

— Timber production
— Forest industry and forest products
— Forest resources and forest management, including forest protection and wildlife management
— Afforestation
— Supply and distribution of wood.

The central forest authority no longer has responsibility for the central research institutes, since these have been relocated and are now responsible to the provinces. Similarly, the Academy of Forest Science, formerly dependent on the Ministry of Forests, has been moved to Harbin and is under the leadership of the revolutionary committee of the province of Heilungkiang, the province which contains the richest of China's forest resources.

The external relations of the central forest authority are conducted through the Bureau of Foreign Affairs of the Ministry of Agriculture and Forests.

### The forest service

It follows that it is no longer possible to speak of a state forest service in the generally accepted sense, i.e., of an independent forest service with a hierarchical chain of command running down through forest regions and forest conservancies. Instead, agriculture and forestry are integrated at all levels, from the Ministry down, usually in the agricultural and forestry bureaux of the provinces, administrative districts, counties, etc. These bureaux are under the political control of the revolutionary committees at the respective levels, and the bureaux at the several levels deal with agricultural and forestry matters alike, along with the interrelations between agriculture and forestry. Naturally, the forestry members of these bureaux have very frequent contacts with their forestry counterparts at the immediately higher and lower levels.

These bureaux, at the appropriate levels, have direct responsibility for the state-owned sector — state forests, state-owned forest industry enterprises, research institutes. Not, however, for forestry education institutions, which ultimately depend, through the education departments or bureaux, on the Ministry of Education. The other important function of the bureaux is to give guidance and technical advice to the collectively owned sector — in essence, the communes, production brigades and teams — as well as to other organs and institutions conducting forestry activities; these include railways, mines, factories, and so on.

What are these services which the forestry bureaux (and the state-owned enterprises for which they have responsibility) provide to the collectively owned sector? I discovered, in the areas I visited, that they go far beyond professional advice and technical assistance. Moreover, they go far beyond what is normally encompassed by a forestry extension service. Most important, I believe, are the education and training activities. These take many forms: short training courses, one-day or one-week technical consultations for cadres, technicians or model workers, arranged at provincial, county or district level; the promotion of exchange visits; on-the-job training in sawmills, timber yards, forest farms and research institutes; preparation of information sheets and instructional pamphlets; and so forth. Some of this is carried out in conjunction with the provincial forestry colleges. In addition, each state enterprise has a demonstration function. Next in importance, I suppose, comes the on-the-spot advice offered to the communes, brigades and teams by the staff of the forestry bureaux, state forest farms and research institutes. These staff now constantly visit, and for sustained periods work alongside members of, the communes. Any new problem cropping up, therefore, is promptly spotted, and measures to cope with it put in hand.

They give advice on management, and in some cases actually provide management services until the collective has acquired its own nucleus of trained and experienced people. They act as animators, persuading the communes to undertake various kinds of forestry activities, providing the know-how and even lending executive staff to get things moving. They supply seed and planting stock. They organize experiments and trials. The relationship between the state and collectively owned sectors in forestry — at least in the areas I visited — is a living and fecund one.

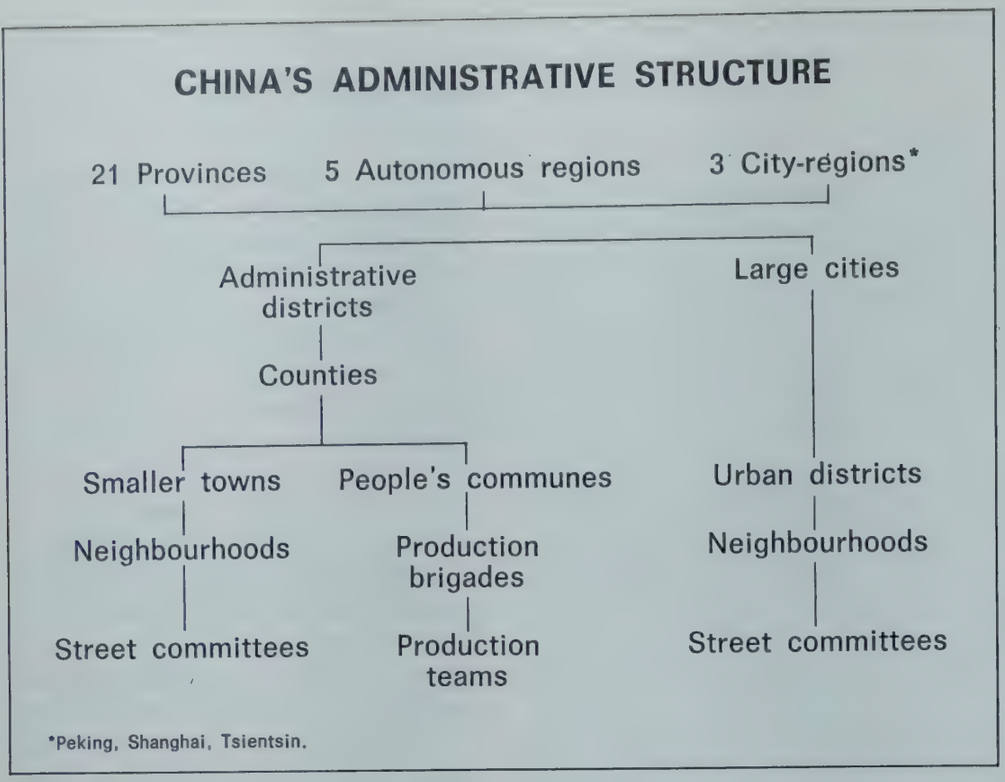
### Starting from scratch

Has it always been that way? Apparently not. An example was given by Liu Ping, chairman of the revolutionary committee of the Dune Fixation and Shelter Belt Experimental Station at Chang Ku Tai, close to the border with Inner Mongolia in northern Liaoning.

" We came here in 1952, starting from scratch, knowing nothing, " he told me. " After many initial mistakes, we got the dunes fixed and the march of the desert halted. As you see, we already have natural regeneration under some of our early plantings. We built shelterbelts, reclaimed land for the plough, and saw our crop yields go steadily up. We were pretty pleased with what we had managed to achieve on our 200 or so hectares. But during the cultural revolution, we came up sharply against some basic questions: What is all this in aid of? Whom are we supposed to serve? We decided we had spent far too much time and effort on our own show, and far too little on helping the communes round here to benefit from our experience. So we changed course. Mind you, we try not to let our programme here fall behind. But we spend much more time out with the production teams, helping them to fix dunes and set up shelterbelts. As a matter of fact, we learn a lot faster ourselves that way too.

" The same applies to cultivation of fruit trees, " he went on. " Everybody told us fruit trees would never grow up here. But we've made 80 varieties of apples, pears and grapes grow. We used to show them off proudly to anyone who would come and look. But since the cultural revolution, we have been training technicians from the

[1] For a succint account of political structure see Joan Robinson, *Economic management China 1972*, London, Anglo-Chinese Educational Institute, 1973.




production teams in how to get fruit orchards going and keep them running, and we ourselves leave the station and work with them to help them set up fruit orchards."

**Where to put forestry**

Liu Ping's story was one of many I heard in a similar vein. Whatever may have been the situation of the state forestry sector before the cultural revolution there is no doubt that today it is the very antithesis of a bunch of desk-bound bureaucrats and ivory tower researchers.

There has long been general debate among foresters of the world as to the desirability of including forestry among the responsibilities of agricultural ministries. The consensus has been that, whether included within the agricultural ministry or not, there is need for a separately organized state forest service with a high measure of autonomy. The arguments rest partly on technical considerations: forestry is, generally speaking, a long-range activity, and its successful conduct requires not only a specialized staff, but also sustained financial support; i.e., not subordinate to oscillations in forest revenue or the financial vicissitudes of the central exchequer. But there are political reasons as well. Most agricultural ministries deal with a wide variety of subject matter, and issues arise daily which are urgent and pressing. Moreover, they all operate in an area which is politically sensitive. Where there is competition between agriculture and forestry for resources — be it land or finance — and where forestry is handled in a department or section of the agricultural ministry, that department tends to be a Cinderella department. As the foresters lament bitterly: "Trees have no vote."

This is especially true of many developing countries, where a high proportion of the working population is employed in agriculture, and where the prevailing agrarian structure often gives rise to acute social tensions. This has usually meant that the forestry sector has been grossly neglected, and its potential contribution to the agricultural sector itself overlooked. If governments and politicians choose to ignore, or pay only lip-service to, the multiple role of the forest and its development potential, then forest consciousness is not likely to spread among the people. This is why many foresters have argued for the establishment of a separate ministry of forests in those developing countries where the forest resource is sufficiently rich to enable it to play a significant role in overall economic development.

Does this mean that the abolition of the separate ministry for forests in China represents a step backward? No, because the situation in China is quite unlike that in other developing countries.

Firstly, there now exists in China a degree of forest consciousness that is unequalled anywhere else in the world, save possibly in parts of Canada and some of the nordic countries. The fact that forestry affairs have for long been conducted by a department which enjoyed the status of a separate ministry has probably helped to create this. But the main underlying reason for this is the importance attached to forestry by the Chinese Communist Party, and the periodic and vivid dicta of Chairman Mao concerning forestry. These have succeeded in creating a widespread awareness of the significance of forestry. Secondly, although most of the presently productive forests are in the state sector, much of the newly created forest, and forests yet to be created, have been and will be established in and by the people's communes, while new plantings in the state sector will be heavily dependent on labour furnished by the people's communes. Thirdly, few countries have such dire need of protective afforestation as has China, and the establishment of shelterbelts, windbreaks and watershed protection forests must be closely integrated with agriculture — must, in fact, be part and parcel of agricultural planning.

**An upsurge of activity**

There is no reason to suppose, therefore, that the abolition of the separate ministry of forests has led to, or will lead to, any neglect of forestry. On the contrary, there is every evidence that, taken along with all the other consequences of the cultural revolution (the devolution of authority, the relocation of research institutes, staff transfers to lower levels, the requirement that all cadres shall spend at least a fourth of their time at the production front, the contribution of the middle school students, and so on), there has been a considerable upsurge in forestry activity since the cultural revolution. This is what is claimed, and so far as afforestation is concerned the age composition of the plantations which I

saw in various parts of China fully bear out this claim.

Thus the integration of agriculture and forestry, which has taken place at all levels in China, has had a positive impact on both agriculture and forestry. This integration has been a conscious process. " We believe we have resolved the age-old conflict between agriculture and forestry. " This statement was first made to me in Heilungkiang, where forestry is the dominant activity. But it was echoed in Hunan, where the agricultural sector predominates. The very fact that it was made repeatedly indicates an awareness that in the past the two sectors were seen as conflicting, representing competing claims on land and resources.

Without doubt, China's most spectacular achievements since liberation have been in the area of water conservation — taming the rivers. No visitor to China in recent years has failed to be impressed by the sheer magnitude of the work accomplished. Although much still remains to be done, great strides have already been made toward removing the threat of flood, diminishing the impact of drought, enlarging the irrigated area and mobilizing hydroelectric power. Several of the major schemes have been centrally conceived, and implemented by the provinces concerned. But these major schemes are complemented by hundreds and thousands of smaller schemes, initiated and carried out at lower levels. What is truly staggering is the amount of human effort that has gone into this work. To give but one example, the repair and reinforcement of the dikes along the lower reaches of the Yellow river alone involved 350 million cubic metres of earthwork and more than 9 million cubic metres of stonework. This was carried out with virtually no earth-moving machinery, by sheer muscle power, making use of shoulder poles, hand tools, and primitive, locally devised lifting devices. The taming of China's rivers has required, and will continue to require for some time yet, literally hundreds of millions of man-days, and the main bulk of this effort has been furnished, and will in future be furnished, by members of the people's communes. It is doubtful, to say the least of it, that this effort would have been forthcoming had not commune members been persuaded that it would in due time contribute to their collective and individual well-being. It is equally doubtful whether the effort would have been sustained had not the works accomplished started to give palpable results, in the shape of increased yields, fewer harvest-failures, etc.

WHEAT FIELDS SHELTERED BY TUNG TREES (*Aleurites cordata*)

*The accent is on protection forestry*

### Watershed afforestation

The example of the lower reaches of the Yellow river could be supplemented by countless others. But it is less well known that, from the very start (and beginnings were made in the liberated areas even before 1949), similar attention was paid to regulating water flow and countering soil erosion in the upper catchments, through afforestation. Here, too, the effort was on a gigantic scale, and the claims advanced through frequent news releases in the early days as to areas afforested and number of trees planted, both on the watersheds and in dike consolidation, were of such a magnitude as to strain the credibility of most people in the west — including mine.

Travelling through China today, and talking with forest officers at various levels, it becomes obvious that these claims were not exaggerated. Undoubtedly, however, much of this work was misdirected and of low quality, so that in many cases survival rates were very low indeed.

Chinese foresters are very frank about these mistakes. In many instances, they point out, afforestation campaigns were not preceded by surveys of soil quality and appraisals of climatic conditions, so that wrong species were frequently selected. This led to low survival rates, and poor growth among the survivors. There was little emphasis on seed selection in the early days. Planting techniques left much to be desired — there had been inadequate tests and trials. Because China had had but little experience of man-made forests of, for example, pure pine species, when these plantations were invaded by pests, as happened in south China, prompt counter-measures

were not taken. But the principal culprit seems to have been inadequate tending: neglect of weeding and hoeing, and failure to carry out thinning in due time. Certainly, in discussing these problems with workers and technicians of commune production teams and forest farms, this seemed to have been the lesson which had been most thoroughly learned. Time and time again I was told that after-care was twice as important as planting techniques in assuring success.

### Successes and failures

It would, however, be a great mistake to write off altogether the efforts of the 1950s and early 1960s. True, there were many failures, and even more cases of incomplete success. But this is not the whole picture. There are many success stories too, and I saw a number of healthy, fully stocked plantations that had been created in that period. It is not possible, on the basis of my limited observations, to quantify the success ratio, but by and large the best plantations that I saw that had been established during that period tended to be in areas which already had a forestry tradition.

Looking back, it is evident that the volume of forestry expertise and experience available in China was insufficient to give technical underpinning to an afforestation programme of unprecedented magnitude. Moreover, a large proportion of this expertise and experience was concentrated in the forested regions, charged with the task of re-establishing and expanding the timber supplies needed to sustain China's development programme. The remaining technical forces were therefore inevitably thinly spread, and not always available where needed. Much, not surprisingly, was located in centralized institutions and at provincial and county offices.

New forests, of course, are created by people, not by professional foresters, just as new towns are built by construction workers, not by architects. The job of the professional forester or forestry technician is to provide guidance to the men and women carrying out the work. He draws on the accumulated experience he has digested and makes use of the technologies he has mastered in order to help the people on the spot to resolve any unforeseen problems that may arise. The masses that created the new forests in China in the 1950s and 1960s not only lacked experience, but they were facing a host of technical problems not previously encountered. And they were grievously lacking in the kind of guidance that would have enabled them to shorten their learning experience and rectify errors quickly. The wonder is, not that there were so many failures, but that there were so many successes.

Measures taken during the last 15 years, and notably since the cultural revolution, have radically altered the situation. The most important of these are: the steady build-up of the corps of trained foresters and technicians; the designation, in each production team, of commune members with special responsibility for forestry affairs within the collective, and their training through thousands of short courses; the creation of a widespread forest consciousness, largely through the schools; the decentralization of research and training institutions, and the radiation of technical staff to the production front; and the stipulation that all cadres and technicians shall spend a significant proportion of their time in actual production.

### Survival rates

These are the basic reasons why new plantings carried out during the last seven or eight years (and new planting still proceeds on a colossal scale) show good survival rates. Time after time, I passed hillsides where single stems or clusters of trees of 5-10 metres — the survivals of earlier plantings — stood out from a 100% cover of young trees established within the last five years. Similarly, during my long road and rail journeys, I saw that many gaps in early line plantings had been made good. I cannot of my own knowledge say that this is true over the whole of China. But I do know that it is true over much of Heilungkiang, Liaoning and Hunan, along the communication routes connecting these provinces, and in the agricultural communes around Harbin, Peking and Kwangchow.

Thus the integration of agricultural and forestry responsibilities at the successive levels, from the Ministry downward, has led to vigorous and widespread forestry activity, mostly sponsored by the people's communes, and this activity has been given a tremendous fillip by the changes which have come about as a consequence of the cultural revolution. Much — in fact, probably most — of this activity has been in protective afforestation: dune fixation, shelterbelts, catchment afforestation and dike consolidation. But a good deal of effort has also been devoted to amenity planting — along major and minor roads, in and around the communes, around factories and workshops, in city streets and parks, and in restored and newly created recreation areas close to the cities.

### Production forestry

This does not mean that productive afforestation, planting designed primarily to provide industrial timber, has been neglected. Nearly every commune that I passed through had devoted some areas to timber production, over and above the ubiquitous road, field and stream line-planting. Sometimes this was designed to provide fuelwood, but more often it was aimed at the production of construction and transmission poles and, eventually, of saw timber. Poles still play a big role in the construction of both dwellings and nonresidential buildings in the countryside, and most communes, adhering to the doctrine of self-reliance, are seeking to make themselves independent of outside supplies of suitable timber. Heavier industrial timber still comes for the most part from the traditional timber "export" zones, notably northeast China, but considerable efforts are now afoot to create new bases for sizable forest industry complexes, as, for example, the Chinese fir campaign in Hunan. As and when adequate local timber supplies become available, the communes themselves establish processing plants: sawmills, joinery shops, furniture factories and so on. The major forest industry enterprises above the commune level on the mechanical woodworking side come under the aegis of the appropriate agricultural and forestry bureau. This may be, depending on the size and im-

TIMBER MOVING THROUGH KIAMUSZU STATION, HARBIN PROVINCE

*The need for big reserves of industrial timber is now being stressed*

portance of the enterprise, at the district, county or provincial level.

On a world scale, forestry is moving steadily toward greater emphasis on man-made forests, artificial plantations of native and exotic species with a much shorter maturing cycle than obtains in natural forests. China is no exception. Even so, much of forestry is still a long-term business, and long-term planning is therefore essential.

Each provincial authority has been asked to prepare proposals for the progressive development of forestry activities over a 12-year period. The provincial authorities are presently consulting their constituent counties and districts, and through them, the communes, preliminary to drawing up provincial proposals. Once this stage has been completed, the provincial proposals will be discussed centrally, modified, adjusted and integrated to provide the basis for China's first national perspective plan for the forestry sector. One must assume that the necessary consultations with the ministries and organs responsible for important aspects of forest industries will take place throughout.

**Supporting agriculture**

The preparation of this perspective plan does not mean that hitherto forestry activity has proceeded without any long-term objectives. The 12-year programme for the development of agriculture (1956-68) was built around the slogan: " Take food grain as the key link, and ensure an all-round development of animal husbandry and forestry." It has meant, however, that outside the timber " export " areas, the main orientation of the massive forestry effort in the countryside has been in the direction of protective afforestation to support agriculture, and productive afforestation to reduce dependence on " imports " of timber from other areas. It is only within the last few years that the importance of creating substantial new reserves of industrial timber to meet national needs has been emphasized. The Chinese fir afforestation campaign in Hunan is a case in point, although a major justification for the campaign lay in the fact that the rural economy faced strict limits to the

BAMBOO HOUSES IN THE TAI AUTONOMOUS AREA OF YUNNAN PROVINCE

*The themes most repeated are "self-reliance" and "serve the people"*

amount of land that could be tilled, so that prospects for a continuing rise in welfare dictated diversification and putting to some use all land that could not be put under the plough.

In the foregoing pages I have contented myself with trying to give a "feel" of what is happening on the forestry front in China today. Space exigencies preclude a detailed description of what I saw in the various parts of China I visited. But *unasylva* readers may be interested in my main impression, which can be summarized as follows:

1. China is well on the way to becoming the most forest-conscious nation in the world. The principal reasons for this are: the importance accorded forestry in development policy; the appreciation of the multiple role of the forest built up in the schools; the mass involvement of millions of peasants in both productive and protective afforestation.

2. Agriculture and forestry are more effectively integrated than in any other country I have visited.

3. The gigantic afforestation campaign continues unabated — indeed, has intensified in recent years. There were many errors in the early days, but most of these have now been made good.

4. In Heilungkiang, China's timber source, a rapidly expanding network of all-weather roads is steadily bringing previously inaccessible forest into production. Narrow-gauge railways are being torn up and replaced by permanent roads. The emphasis is now on silviculture and management, and on the establishment of permanent management/logging centres (forest farms). Allowable cut should steadily rise to the end of the century.

5. In that part of the "great green wall" which I visited — the Liaoning border with Inner Mongolia — the desert has been successfully halted, land reclaimed for agriculture, overgrazing eliminated, and crop yields inside the new dense network of shelterbelts have risen sharply. Although growth rates are of course low, the earliest new forests are showing ample natural regeneration.

6. Hunan province is halfway along in its campaign to establish a million hectares of Chinese fir (*Cunninghamia lanceolata*) on its bare hills. Take is high, and growth rates good.

7. While the accent is on protection forestry (dune fixation, shelterbelts, dike consolidation and watershed afforestation) and production forestry, recreation and amenity forestry are by no means neglected. China could learn much from the west about the management of recreation forests, but could teach much about urban forestry, which is particularly well advanced.

8. In some cities, air and water pollution has been dramatically reduced. But there are some which still have a long way to go.

9. Statistics at the local level are readily given, and mostly verifiable. Overall national statistics for the forestry sector are not yet being released.

10. The two dominant themes in Chinese society today are "self-reliance" and "serve the people." These are not mere slogans. They profoundly influence the way in which people live, work and behave to each other and to strangers.

11. China has much to learn from other countries, and the Chinese know this. But any foreign equipment or research finding will be scrutinized carefully before it is introduced or applied to ensure that it is appropriate to Chinese conditions. ■

# The need for continuing education

Continuing education should aim at keeping people professionally alive and growing and productive. It is an antidote to the sense of alienation felt by those who believe they have reached their professional limits. The author defines and discusses continuing education in terms of the needs of foresters, forest technicians, workers and managers.

**A.G. Pyman**

Most published works have examined the problem of continuing education in forestry at the postgraduate level. This article looks at a different area: its application to forest workers and technicians.

Continuing education itself is difficult to define in forestry since it seems to mean all things to all people. My proposal is that it is the provision of further education and training to allow a man, at whatever level, to develop to his full potential, so that his competence and professionalism may be of maximum value to the industry.

Seip (1974) has noted that continuing education is changing from the meetings and excursions of the middle of this century — with their lectures and demonstrations concerning actual problems within forestry — to more organized courses. This is inevitable, as technology is developing so rapidly, and continuing education is more often thought of as updating personnel to understand new techniques as well as new thinking and concepts. New problems, new circumstances, in addition to improved technology, also have their influence (Stoltenburg, 1974).

Westoby (1971) stated that once the forester has obtained his licence to practice, he is let loose on society for ever. There is no opportunity of challenging his fitness to practise, even though the problems of today may require a body of knowledge and an assembly of skills that did not exist when he was licensed. This is equally true at all levels in forestry. Updating could be thought of as simply training in the new techniques, but the personal development of the candidate must be considered at all times, just as the impact of the new technology on the general public — and individual members of it — must be studied.

In the whole personnel structure there must be a continuing thread of further education. As technology changes, industry has no doubts about the value of industrial training to teach forest workers a new technique of planting or production, or to give instruction in the effective use of a newly developed machine. Training is often readily available for technicians, but education for the personal development that will help a man to reach higher goals is not always so easily obtainable.

### Terraces of experience

At first glance continuing education appears to be a diagonal line climbing up throughout a career. Closer examination reveals a terrace of experience at every stage after each course of education or training, as the recipient consolidates and absorbs the points that he has learned into his own employment. Eventually he becomes ready in experience and outlook for the next stage, and if he is fortunate he receives another course of instruction and continues to climb the career ladder, rising from the terrace again. According to Ovington (1974) this type of education, in a formal sense, is a privilege of the few rather than the recognized right or need of all foresters.

There are several ways of implementing this lifetime of progression by education and training, some formal, some informal. The obvious way is by on- and off-site training, particularly at the lower levels. One hopes that this would take place as a matter of course, as it does, for example, in the Forestry Commission and in agriculture and other industries in the United Kingdom. The position in sawmilling and harvesting has been stated recently by Swaisland (1974).

Similarly, fairly regular attendance at local or regional meetings, seminars, and discussions as in earlier years, will help a man's technical ability as well as his personal development to some extent, but it is the organized courses that will give the most satisfactory results.

One great advantage — as Ovington says — is that if these courses are held at forestry schools and colleges the opportunity is provided for young students to meet advanced foresters who are also studying, which gives them better motivation and provides a better sense of direction. This is very evident at my own college, which provides a three-year course for suitable, educationally qualified young men who have been forest workers for one or two years (to learn basic skills), and aspire to be technicians. In addition there is a progression of much shorter courses for new entrants, and ambitious older men if they have the necessary ability and inducement, which eventually lead to technician and managerial level.

This system of short courses has been

A.G. Pyman *is Head of the Forestry Department, Cumbria College of Agriculture and Forestry, United Kingdom.*

evolved over the past few years, based on the "terrace of experience" concept. After about eight years of full-time work and part-time study, with regularly spaced short courses, it is possible for men of suitable inclination and intelligence to reach managerial status. The college or other agency must at all times be ready to advise the aspiring student regarding his chances of advancement.

### Three phases

With this range of courses in mind, the United Kingdom's Joint Advisory Committee on Agricultural Education, reporting in 1973, made recommendations suggesting a structure of forestry education divided into three phases. The first, involving two blocks of educational release, each of six weeks' duration over a period of two years, would aim to educate a general craftsman. The second phase, providing specialized craft work, would have a specialized craftsman as its target. The third phase would cover education for foremen and junior technicians, the former intended for fourth-year students who have progressed through the three-year short-course series at craft level. The suggestion is made that a separate course should be provided for the potential full technician who wishes to avail himself of the short courses or lacks the academic entry qualifications for the full-time course.

These courses would be in addition to the recently established Technician's Course (Ordinary National Diploma in Forestry), a three-year "sandwich" course, described by Danbury (1974), and are similar in structure to the courses currently being examined by the City and Guilds of London Institute and the two Royal Forestry Societies.

The culmination of these studies, for suitable candidates, is the examination for the National Diploma in Forestry, which is recognized (at least by the private sector) as a managerial qualification, and admits the holder to full professional membership of the Institute of Foresters of Great Britain.

All these courses are educational, although the lower ones contain a training element in the form of initial instruction.

It is not envisaged that skills can be developed in the college situation and, ideally, supporting training must be instituted in the working environment, by either on- or off-site instruction, or by a combination of both. Once the courses are established, the terraces of experience can be made more meaningful by the introduction of training in skilled work and of supervised practice.

Because of the lack of continuing education in some places, on reaching a particular terrace the aspirant stays there; sometimes there is no incentive for him to take the next step.

Forest workers and technicians may find their individual zeniths and stay on their particular planes — this is true of all schemes of advancement — but always there should be motivation and incentive, in the form of further education, to allow men of ability to rise. There should always be, in addition, a counselling service to advise them on their suitability for further courses.

If there is no provision for capable candidates to advance, there will inevitably be a sense of alienation and frustration. This is increasingly evident today, in particular among workers and technicians. They feel that they have reached the limits of their individual development (which is often not the case) and consequently tend to lose interest and "live" less in their work.

The initiative of potential managers must be nurtured, and opportunities must be provided for those of ability to reach higher positions. Maximizing its manpower resource will help world forestry to reach its full development. Here is a vast area where continuing education can play a major part; a huge reserve of potential managers, managers with a practical background, who will serve forestry well. But it will require more than just the provision of continuing education to capitalize this latent force; often there are distinct artificial barriers prevailing on this logical development.

As George Bernard Shaw once observed, all professions are conspiracies against the laity. In some ways they

FOREST TECHNICIANS LEARN SURVEYING AT LATTAKIA, IN THE SYRIAN ARAB REPUBLIC

*Long careers enhanced by short courses*

can be conspiracies against themselves. The developing countries were told to get rid of the term "subprofessional" with its implication that those phases of formal forestry education which precede the university level are somehow less important, even subhuman. They were also told never to forget that the three-tier system that obtains in much of the developed world harks back to a class-structured society (Westoby, 1971). This theme was argued further when it was said that the tern "professional forester" has its roots in bygone times when hunting was the pastime of princes. As the forests owned by the princes gained importance for timber production, foresters were given responsibility for this sector too. In countries where development has taken this course forest management has old traditions, and the social prestige enjoyed by professional foresters is considerable (Osara, 1974).

It was realized early that the requirements of forestry can only be met by specialized personnel, by professional foresters, and that the persons in leading positions should receive university level education. Nevertheless in many countries — Finland, for example — the trained "semiprofessionals" (the forest technicians) are of great importance in forestry (Osara, 1974).

It is in this area that we must clear our minds. Is a manager a professional forester or not? Yes, most certainly he is if he has a university background; if he has come from the technician stream, however, he may be only halfway there, but he has probably climbed from "sub" to "semi."

A scientific education does not necessarily make a good manager, any more than a technical one does. The ideal men for the job are articulate, capable and self-reliant, with the ability to organize, work and live in remote communities.

The technician often has these qualities and, although he may lack a truly scientific background and not be a technologist, it is often the professionalism of the forester that he has to develop, in the same way as the graduate. His base of education may not be as broad as that of the university-trained manager, but his work may more than qualify him.

In forestry in the past we have not had the technician specializing to a great extent, thus he may be called a "broad-band" technician. As technology develops there is a tendency for enterprise managers to be educated, so there may be an increasing number of "narrow-band" technicians. Continuing education has importance here, when a man's specialized knowledge can be used as a base on which to build higher managerial status, giving access to advancement.

### Difficulties and incentives

There are obvious difficulties. The one most frequently raised is the impracticability of attracting a student back to his studies when domestic and family pressures are upon him. This situation can be eased when the rises from the terraces of experience are of limited duration, measured in weeks or, at the most, months. Another incentive that should not be overlooked is the attraction of providing the longer courses at overseas centres; the student who might fight shy of a three months' course in his home country will readily attend one of twice the duration in another.

In some developing countries there is a moral obligation to upgrade able technicians to higher levels, for some of them never had the opportunity to attend universities, often because they did not exist in their present form when these men, who have usually rendered impeccable service, were ready to commence their education. These technicians should not be overlooked by having younger men brought in over their heads.

Some cynics are firmly against the very concept of continuing education, which they see as an escape from work. I do not share this view, as the continuing education outlined here is by no means an easy task, particularly at the upper limit of its progression to managerial capacity and professionalism.

The view can be more fairly taken that, although the educational load is heavy, the relief from day-to-day working anxieties can open new horizons for the student and actively assist and refresh him by the well-earned change.

In the past it was often thought that the content of one course should not overlap another, and that the compartments between the education levels of personnel should be rigidly defined. There is now evidence that this need no longer be so severe in forestry education. The forester's service may be devoted as much to the expensive machine as it used to be to the wealthy princes or, indeed, to the trees. Thus we should take a closer look at what the interim position of today's student will be in, say, ten years' time — what courses are needed now to make him tomorrow's manager? We are very sure when we look at the forest, we know how it will develop, we are very good at making forecasts of yield. We know our forests! What we are singularly lacking is the ability to forecast the structure of our supplementary courses to ensure that our forest workers and technicians reach their full potential and gain their goals at the peak of their careers.

Here is the great challenge. If more thought and effort can be devoted to this neglected area of continuing education, forestry will be the better for it. ■

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# REMOTE SENSING FOR TROPICAL FOREST SURVEYS

To many, remote sensing means satellites and a sophisticated, expensive technology. In fact, remote sensing for forestry is still being carried out for the most part with conventional cameras, films, aircraft and interpretative equipment adapted or developed for this work. The authors discuss these remote sensing photographic techniques as used in tropical forest surveys.

**John A. Howard and Jean-Paul Lanly**

Tropical forests, in the broad sense — woody vegetation types ranging from open savanna woodland to closed high forest — cover a total area of approximately 19 million square kilometres, or 14% of the world's area, and slightly less than half of the world's forested area. They are nearly all located in the less developed parts of the world, and for the countries concerned they represent an important resource, from both the production and the conservation points of view.

### Disappearing cover

As is widely recognized, the tropical forest cover is being rapidly degraded and/or depleted under the combined effects of shifting cultivation, overgrazing and destructive logging. Several comparative analyses have provided significant figures on the depletion of tropical forests in different parts of the world. For instance, the total forest cover of the Ivory Coast was reduced by 30% between 1956 and 1966 (Lanly, 1969), and 40% reduction occurred in the region of the Magdalena and Sinu valleys in Colombia between 1956 and 1965 (FAO, 1970).

In view of their economic and environmental importance, the tropical forests need to be continually monitored within each country at the various levels of planning, control and management, and also on a regional and worldwide basis, to alert the international community to the detrimental effects of forest exploitation and the measures to be taken.

As commonly applied in forestry, the term "remote sensing" relates to the collection from a space platform of data about objects on or near the earth's surface (Parker, 1962), but it is increasingly extended to include the analyses of the data collected. The space platform is usually a fixed wing aircraft, occasionally a helicopter, now sometimes a satellite and experimentally a rocket (e.g., Skylark — see Ridgway and Hardy, 1973).

John A. Howard, *a forester, is the senior officer of FAO's Remote Sensing Unit.* Jean-Paul Lanly *is the FAO Forestry Department's officer responsible for forest surveys.*

In the past, the data-collecting device has been an aerial camera but mechanical scanners are now being increasingly used to obtain thermal imagery, radar imagery (SLAR imagery), and satellite imagery. Nonimaging aerial remote sensing is important in geophysical surveys; however, with a few experimental exceptions such as radar altimetry (Sayn-Wittgenstein, 1970) and laser beam profiling, only image-producing techniques are used in forestry.

### Photographic techniques

This article deals with the use of photographic techniques as a part of remote sensing in the field of tropical forest surveys. By "photographic techniques" is meant those in which a single camera with one or more lenses or a multicamera system is used for sensing in the visible or near infrared parts of the spectrum, with one or more film-filter combinations, and with any type of platform.

Vertical aerial photography was first used in a tropical forest survey in Burma in the early 1920s (Blandford, 1924; Howard, 1970a). By the 1930s aerial photographs had been used in forest resource surveys as far apart as Zambia (Bourne, 1931) and Papua-

MEXICAN FORESTERS ENGAGED IN AERIAL SURVEY WORK

*Rockets are not absolutely essential*

New Guinea (Payens, 1971). In the Burma survey (Irrawaddy delta), several forest types were identified from the photographs at a scale of 1:20 000.

### Establishing the approach

These early surveys using aerial photographs helped to establish an approach to tropical forest inventory similar to that of forest surveys in temperate regions, and which has continued up to the present time. That is the use of black-and-white panchromatic photography with a minus-blue filter (yellow filter), a medium focal length lens (i.e., 15.2 or 20.5 cm) and a minimum sun-angle of about 30°. However, the small photographic format of the early aerial photography (4 × 5 inches) was replaced first by a 7 × 9-inch format, occasionally later by a 19 × 19-cm format, and finally by a 23-cm format (i.e., a 9-inch format).

After the second world war there was an immense surge forward in the taking of aerial photographs for topographic and planimetric mapping in the tropical countries. As these photographs were usually taken at a fairly small scale, the forest photointerpreter had, and usually still has, to work at scales between 1:30 000 and 1:60 000, and occasionally smaller. As examples of very small-scale aerial photographs in tropical countries, one can quote 1:80 000 in the northern part of the Ivory Coast, 1:84 000 in Papua-New Guinea, 1:92 000 in some parts of the Sahelian zone, and recently 1:120 000 in Kenya.

Somewhat surprisingly, small-scale photographs are not as restrictive as might be expected, because the information required from photographs of tropical forest areas is usually of a more general type than that required from forest surveys in many temperate countries. In tropical inventory, photointerpretation is often confined to the delineation of forested lands, broad forest types, and dominant structural units of vegetation (i.e., plant formations/subformations). This type of information facilitates the exclusion of areas in which marketable species do not occur; and, more generally, serves for a stratification ahead of ground sampling — thus increasing sampling efficiency — either by reducing the sampling error for an equal sampling intensity or by reducing the sampling

intensity required for the same level of sampling error. These delineations are often made on or transferred to mosaics and maps compiled from the same photographs. Sometimes the only practicable forest stratification is one based on land units (Howard, 1970b).

ever, accessibility mapping has been neglected for forest inventory.

The above applications of photointerpretation refer to forest characteristics and classification. When the units for interpretation are the trees themselves, aerial photographs have proved

*Mangrove forest (1) with dark and light species is easily distinguished from adjacent dry-land forest (2) on hills. Poor forest composition on steep ridges is indicated at (3). The forest is in Asia and the scale is approximately 1:40 000 (ITC photo).*

Also, the aerial photographs, through the use of measurements of slope and other terrain characteristics, help in the stratification of forested areas as regards accessibility, as in the FAO surveys in Madagascar (FAO, 1971b) and Gabon (FAO, 1973). In general, however, much less useful in the tropics than in temperate zones, where, as in North America for instance, they have been mainly used at scales between 1:10 000 and 1:15 840 (i.e., 4 inches = 1 mile) to obtain information on individual tree and stand heights, number of trees per unit area, crown characteristics, crown widths and stand volumes per species.

### Identification

The identification of the species of individual trees from small- and medium-scale photographs in the tropics has been achieved in relatively few cases. There are several major reasons for this, among which: the many tree species occurring in tropical forests — even tropical woodland may contain over 40 tree species per square kilometre (Howard, 1959); the very variable phenology in space and time; and the poorly defined vertical layering (Rollet, 1974). Two or more tree crowns may appear as a single crown on the photographic image, and large crowns in the upper storey may be interpreted as two or more trees. However, at a scale of 1:5 000, crown counts on panchromatic black-and-white photographs over a tract of rain forest in Surinam were reported: "to offer possibilities for assessments of the timber potential" (Versteegh, 1974).

Occasionally a species or genera is distinctive, such as *Dipterocarpus* spp. in Thailand and *Doona congestiflora* in Sri Lanka. Counts of Limba trees (*Terminalia superba*) carried out on 1:50 000 panchromatic black-and-white aerial photographs in the southern part of the Congo, with errors (but not biases) less than ± 25%, allowed an approximate valuation of the stands with regard to this most important species (Centre technique forestier tropical, 1965). Usually, however, photo typing of a single species within mature forests of the tropics relies on the gregarious nature of the species, often linked with edaphic conditions: mangroves, littoral stands of *Campnosperma panamensis*, riparian forests of *Guibourtia demeusei*, *Hura crepitans*, *Mora excelsa* and *Prioria copaifera*, and pure stands of Leguminosae (e.g., *Gilbertiodendron dewevrei* and *Monopetalanthus* spp.).

### Singling out species

As a plant subformation is a structural unit of vegetation and not a floristic unit (e.g., association), its spectral radiance/albedo is often distinctive, which results in a characteristics pho-

tographic relative grey scale value. Thus, sometimes, a species can be singled out through recognition of the (plant) subformation which contains it. The importance of relative grey scale values (Stellingwerf, 1966; Howard, 1970a) helps to explain why in tropical forest photointerpretation a wide range of photographic scales is acceptable; and, although requiring greater photointerpretative skill, as much usable forest information may be obtained from photographs at a scale of 1:80 000 or smaller than from those at much larger scales. Infrared black-and-white photography has been used to advantage on several occasions in tropical Africa, since better haze penetration occurs at the longer wavelengths of infrared radiation reflected from the earth's surface. Contrast and sharpness are often much better and interpretation may be more reliable. Moreover, the boundaries of exposed moist soil and water surfaces are better defined. On several occasions infrared photographs have proved more useful than panchromatic photography in the identification of tropical species; for example *Musanga cecropioides* in the Central African Republic (Lanly, 1972), and *Virola surinamensis* in Guyana (FAO, 1971a).

*A typical example of a growing coast. Three shore lines can be seen with* Avicennia nitida *in three stages of development. The younger* Avicennia *are darker, with smaller crowns and lower height than the older ones. The forest is in Surinam and scale is about 1:20 000 (ITC photo).*

Suprisingly little has been published on the role and application of aerial colour photography in tropical forestry (i.e., normal colour and infrared/false-colour photography). On first considerations, the taking of colour aerial photographs may appear to be much more expensive than black-and-white photography. Colour film is more costly (cost ratio possibly 1:5), more exacting to use (fewer flying hours per day and flying days per year), more expensive to process (cost ratio possibly 1:4), wastage is greater and the risk of damage to processed film by fungal attack in the tropics is considerable. However, to base a planning decision on these factors alone would be misleading, since the largest fixed cost factor, the taking of the photographs, remains approximately the same. For a large area having known favourable weather conditions, and readily accessible to contractors, the cost ratio of normal colour to black-and-white photography would probably not exceed 5:4 — the cost of preparing maps, which is relatively expensive, is additional. If, as often occurs, the colour photographs provide more usable information to the photointerpreter, or improve the efficiency of the forest resources survey, then the cost/benefit of colour vis-à-vis black-and-white can be expected to increase.

### Mapping accuracy

The main contribution of single camera colour photography to tropical forestry in recent years has been to improve the mapping accuracy of forest stand boundaries and to improve forest-type mapping, including the better separation of the understorey and age/height classes, and occasionally an improvement in the identification of tree species, especially when used in combination with other films (Stellingwerf, 1971). However, colour photography is still used considerably less in the tropics than in temperate regions and corresponding research is even more reduced.

Recently there have been several at-

tempts to use very large-scale colour panchromatic photography (e.g., 1:5 000) to improve the identification of tree species. Experiences in Surinam (de Milde and Sayn-Wittgenstein, 1973) and in Cameroon and Gabon (Clement and Guellec, 1974) were mainly based on the stereoscopic interpretation of forest species from normal colour photographs. For example, 73% of the okoumés (*Aukoumea kleineana*) examined in Gabon had a characteristic image which was identifiable on the photographs.

Large-scale colour photography is also well suited, as in temperate regions, to the monitoring of insects and diseases, and fire-damaged forest stands (Wolff, 1966; Hildebrandt and Kenneweg, 1970). Black-and-white and colour 70-mm and 35-mm aerial photographs have also proved in east Africa to be valuable in wildlife surveys (Howard, 1970a).

### Multiband photography

Colour photography in the form of strips to supplement existing smaller scale photography for topographic and planimetric mapping may prove a useful development.

Multiband photography implies the use of two or more simultaneously operated cameras, or the use of a multilens camera with selected filters (usually narrow-band) and black-and-white (usually infrared). For convenience, the latter type of aerial photography will be termed multispectral.

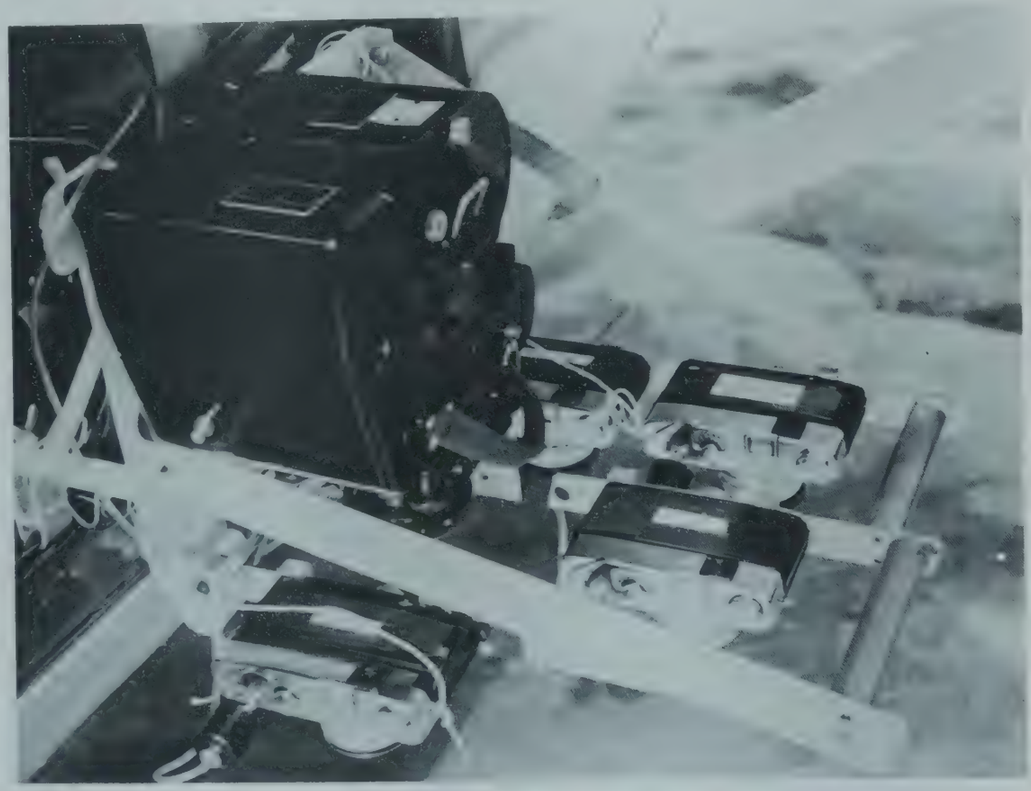
Some years ago, as in the French national forest inventory, multiband photography consisted usually of simultaneous black-and-white panchromatic photography (with a minus-blue filter) and black-and-white infrared photography (with a deep red/black filter). The Institut Géographique National has also used this two-camera technique in Africa since 1960 (Stellingwerf, 1971). However, there is a tendency nowadays for these film-filter combinations to be replaced by or used in combination with simultaneous normal and infrared colour photography. Sometimes, a cluster of four 70-mm format or 35-mm format cameras are used. In a study carried out in Surinam by the International Institute for Aerial Survey and Earth Sciences, four 70-mm cameras were used. Experimentally, in North America, clusters of up to nine 70-mm cameras have been employed (Lauer, 1971).

### Multispectral photography

Whereas multiband colour photography is based on the subtractive theory of colour and uses three-layer film, multispectral colour photography relies on single-layer black-and-white film and uses an additive colour viewer (in the laboratory) to combine three or four film exposures taken simultaneously into a single colour scene. Despite the disadvantage of a small film format, multispectral photography is potentially useful to foresters, since it is selective by recording in key parts of the solar spectrum (e.g., for disease detection). Several different types of additive colour viewers are marketed, principally for use with ERTS (Earth Resources Technological Satellite) imagery; and vary in price up to about US$30 000. Although multispectral aerial photographs have been taken of tropical forested areas, there are no known published results relating to tropical forest resources.

Nearly all aerial photographs have been taken at flying heights of less than 9 400 metres (i.e., within the troposphere) to provide photographs at scales larger than 1:85 000. Recently, pressurized aircraft have been used for nonmilitary photography at altitudes up to about 20 000 metres, providing imagery at scales of 1:120 000 or smaller, and this type of photography may be expected to increase if regional and national land-use and land-resource surveys are needed with a photographic resolution of 3 to 5 metres, which is considerably superior to the resolution of ERTS-1 imagery. There remains, however, a major altitudinal difference between high altitude aerial photography and outer space photography. Skylab imagery, for example, was taken at an altitude of 660 kilometres.

Outer space photography (Gemini-4, Mercury, Skylab, Skylark) like ERTS-1 imagery, provides a synoptic view of an extensive area of the earth's



*A cluster of cameras mounted on the outside of a light aircraft includes a 70-mm aerial reconnaissance camera for strip photography and four synchronized 35-mm cameras for pinpoint photography. This versatile combination of equipment is inexpensive, and easy to assemble and use.*

surface. A single Skylab 70-mm colour transparency covers a ground area of about 26 500 square kilometres. Thus, the forester is able to observe major geological or geomorphic features influencing the forests of which he was not previously aware, and this, in turn, may influence his approach to forest resource inventory and regional and national forest management. Considerable information is available on drainage patterns and drainage densities. Conifers can be separated from hardwoods and often these in turn can be distinguished from "mixed" forest, regeneration, bare land, other plant formations (shrubland, grassland) and some other plant subformations (closed versus open woodland). On high quality Skylab colour transparencies, the photographic resolution of some ground objects has been observed as about 10 metres, which is indicative of the importance of space imagery in the future. Unfortunately, unlike ERTS imagery, present space photography covers but a small part of the earth's surface.

## Overcoming deficiencies

As pointed out earlier, the forester often has to work with photographs taken for purposes other than a forest resources survey. These photographs, frequently at a small scale and sometimes outdated, may not contain all classes of forest information or the detailed data needed for the survey; the deficiency is largely overcome by additional field sampling, which is usually expensive. Alternatively, the deficiency may be overcome by further aerial photography of selected ground areas. However, this second approach using supplementary photography has been neglected by foresters.

Several publications (e.g., Langley, 1969) advocate the use of supplementary photography in combination with multistage sampling from very small-scale photographs and/or satellite imagery. Supplementary large-scale aerial photography from light aircraft is taken of widely spaced strips (vertical strip photography) or of scattered small ground areas (vertical or oblique pin-point photography). Uses include updating of information on the forest cover and shifting cultivation as recorded on old photographs, improved identification of tree and shrub species, progress of forest disease and insect damage, and rangeland information on wildlife and domestic stock. ■

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## WOOD-BASED PANELS INDUSTRY STILL GROWING; STRONGEST PROSPECTS ARE FOR PARTICLE BOARD

Forecasts for the future of the wood-based panels industry are basically optimistic in spite of a continuing economic recession in many of the industrially advanced countries.

This was the consensus at the New Delhi World Consultation on Wood-based Panels in February. The Consultation was sponsored by FAO and the Indian government, and attended by 450 people from 50 countries and seven international organizations.

Economic forecasts were among the major studies presented by FAO and discussed. FAO forecast that wood-based panels consumption was likely to rise to between 225 and 310 million cubic metres by 1990. The high end of this forecast, with a predicted average annual rate of growth of 7% between 1973 and 1990, could be realized, according to the report, if major industrial nations recover from the current economic recession within a year or so and resume the growth rhythms of the 1960s and early 1970s. The lower consumption estimate, of 5.1% annual growth, was based on a slower economic recovery.

The forecast indicated that in any event consumption of particle board will continue to grow faster than that of plywood and fibreboard. It was felt that by 1980 particle board may account for two fifths of the world market for wood-based panel. In comparison, particle board accounted for one third of that market in 1973 and a negligible share 25 years ago in 1950.

Plywood, which had 50% of the market in 1973, might decline to about 45% by 1980, according to the FAO survey. Fibreboard was foreseen as dropping to between 15 and 19% of the market by 1980.

FAO's estimate of 1975 world production capacity for all three types of wood-based panels combined was 123 million cubic metres. This represented an increase of 43.6 million cubic metres over the 1970 capacity of 79.4 million.

FAO calculated the average annual rates of growth of capacity in the industry over the past five years at about 14% for particle board, a little more than 7% for plywood and about 7% for fibreboard. This gave wood-based panels as a whole an annual production capacity growth rate of 9%.

It was generally agreed that the growth of the panels industry had been slowed down by the current recession but that it was suffering no worse in this respect than competing sectors.

It was generally agreed that three factors have played a principal role in the strong growth of the wood-based panels industry over the past 20 years: (1) continued product diversification and the growth of new markets connected with this; (2) broadening of the raw material base which has resulted in better utilization of forests; and, (3) a widespread condition of sustained, overall economic growth, especially in industrialized countries.

The Consultation made recommendations aimed at improving various aspects and areas of the wood-based panels industry. Here are some of them:

**Raw materials:** It was felt that growth in consumption of wood-based panels, particularly plywood, will depend increasingly on the resources of tropical forests. Therefore, it was recommended that there be more processing of logs locally in tropical forests and that integrated production be encouraged for the purpose of fuller utilization of wood. The need for extensive new plantation programmes and increased use of plantation wood in tropical countries was emphasized. Developing countries were urged to adopt technology existing in more industrialized countries in order to enable them to use logs of smaller girth for plywood.

Raw material supplies could also be stretched, it was felt, through use of non-wood fibrous material where economically available.

**Marketing**: Tropical countries were urged to take advantage of the rapidly growing international trade in veneers. But it was felt that developing countries had only limited opportunities in the particle board — and also partly in the fibreboard — export trade, unless they were in a position to make their output into more finished, higher priced products which would be able to withstand freight costs.

Developing countries were urged to strengthen institutional aspects of marketing in general.

Rationalization of the whole range of panel standards was called for both at national and international levels. Product standards, it was agreed, should be oriented more to the "end uses" to which products are actually put, both in developed and developing countries.

**Technology:** The Consultation stressed the importance of speeding up transfer of technology between developed and developing countries. In particular, it recommended greater exchange of experience and information about non-petroleum

### FAO-BRAZIL CONFERENCE ON THE TROPICAL MOIST FOREST POSTPONED INDEFINITELY

The international conference on tropical moist forests which was to be sponsored jointly by FAO and the Government of Brazil has been indefinitely postponed.

The meeting, which was to have been held in Brazil from 29 September to 10 October 1975, was postponed because it was not feasible for the Brazilian government to host it at that time. It was to have been a major international examination of the best ways in which tropical forests of the world should be utilized and to what extent such forests lend themselves to management.

FAO plans to use the position papers prepared for the meeting at the Fourth Session of the FAO Committee on Forestry Development in the Tropics, which is to take place in March 1976.

based chemicals for binders and adhesives, which are essential in panels production. It recommended that more use be made of resins originating in forests of developing countries, such as tannin resins. The high cost of imported petrochemical adhesives was recognized as a serious obstacle to wood-based panels production in developing countries, faced with shortages of industrial development capital in general and foreign exchange in particular.

The Consultation also stressed the need for development of technology for the utilization of mixed tropical forests, where there may be hundreds of species per hectare.

In discussions of technology for developing countries, it was recognized that many of these countries faced unemployment problems and therefore welcomed in particular industrial technology which could be labour intensive and at the same time not sacrifice product quality.

**New products:** Economic and technical aspects of a number of new products were discussed, including boards made with oriented fibres or particles, cement-bonded particle board, and thin boards produced by the continuous method. It was noted that certain new products were undergoing accelerated development, among these waferboard and medium-density fibreboard.

**Economics of investment:** The Consultation stressed the need for more attention to be given to labour-intensive operations for developing countries. These should not only provide employment but can also be more profitable, and should be considered as part of good engineering practices. The Consultation recommended that an industry party be created by FAO to investigate the opportunities for small-size mills for developing countries. Concerning feasibility studies in general, the Consultation emphasized the importance of their being professionally executed and FAO was asked to intensify its activities in this field.

Other recommendations included more regional training centres for wood-based panels production in developing countries and the need for projects which would demonstrate and encourage the use of panels in the building industry, especially low-cost housing. The need for preservative and fire-retardant treatments of panels was also stressed.

Finally, it was recommended that consultations be held every five instead of every ten years.

At the conclusion of the Consultation there was a meeting of the FAO Committee on Wood-based Panel Products, an intergovernmental body consisting of delegates and observers from 22 countries. This group reviewed and endorsed the recommendations of the Consultation.

**PROCEEDINGS OF THE WORLD CONSULTATION ON WOOD-BASED PANELS**

The proceedings of the World Consultation on Wood-based Panels held in February 1975 in New Delhi are now in preparation, and information about their price and how to obtain them will appear in a forthcoming issue of *unasylva*.

As now conceived, the proceedings will contain:

— Basic papers of the Consultation. These were based for the most part on the 147 background papers prepared for the meeting. The basic papers cover production, consumption and trade; raw materials; marketing; technologies and techniques in both manufacture and use of wood-based panels; economics of investment and production.

— The final report of the Consultation.

— Appendixes.

## Sixth International Fundamental Paper Science Symposium

The sixth in the series of International Fundamental Paper Science Symposia is now being planned by the Fundamental Research Committee of the Technical Section, British Paper and Board Industry Federation.

The Symposium will be held at Oxford from 18 to 23 September 1977, and is being organized in association with TAPPI's Paper Physics Committee and the Research Section of the Canadian Technical Section.

## Increased pulp and paper production capacity forecast by FAO

World production capacity for pulp and paper is currently increasing at a steady rate but the outlook beyond 1977 is uncertain, according to an FAO forecast.

FAO presented the annual forecast in May to its Advisory Committee on Pulp and Paper, consisting of members from 24 countries who serve in their private capacity.

The Committee called particular attention to the pulp and paper needs of developing countries. Noting that 96% of all paper and paperboard is produced in developed countries, the Committee recommended that special attention be given by governments, industry and international funding agencies to opportunities for building more pulp and paper mills in developing countries. Members of the Committee from developing countries endorsed in particular the need for international soft loans to stimulate this building. Also, members of the Committee from developing countries foresaw shortages of paper and paperboard of all grades by 1979. In particular, the Committee felt, investment should be encouraged for mills to produce printing and writing grades of paper in developing countries.

FAO gave the Committee a five-year capacity forecast, from 1974 to 1979. However, due to unsettled economic conditions in many of the industrial countries where most pulp and paper is produced, FAO and the Committee agreed that the forecast of capacity for 1978 and 1979 could not reflect recent changes in corporation and government plans and therefore was subject to revision.

The 1975 production capacity for pulp, according to the FAO estimate, is 137.5 million metric tons. Capacity for paper and paperboard was put at 174.6 millions tons. These estimates represent increases of 5.3 and 7.5 million tons and annual rates of growth of 4 and 4.5% for pulp and paper respectively over 1974 capacity. The 1975 rates are slightly behind the average annual rate of growth for these products during the five-year period 1969 to 1974.

The forecast for 1976 was for capacity to reach 143.7 million tons for pulp and 183.1 million tons for paper, representing annual rates of growth of 4.5 and 4.9%.

The 1977 forecast was 149.5 million tons of capacity for pulp and 190.1 million tons for paper, with growth rates of 4 and 3.8% respectively.

The FAO forecast is based on figures received, for the most part, from national pulp and paper trade associations reporting future plans of member companies. It takes three to five years for pulp and paper mills to go from planning to production. Therefore, future production capacity is largely determined by decisions related to the market and general economic climate several years back. Boom conditions in the industry during late 1973 and the first part of 1974 caused plans for 1978-79 to be optimistic, but these are being modified because of the current decline in the market for pulp and paper.

## Nigeria to set up two paper mills

In an effort to reduce its growing paper import bill, Nigeria will establish two new pulp and paper mills during the 1975-80 development period. D.A. Iyamabo, Director of the Federal Department of Forestry Research, who announced the decision, said large wood plantations of about 16 000 acres (6 400 hectares) would be created to provide essential raw materials for the additional mills. Planning for these mills was assisted by the Finnish government. Nigeria's only paper mill, in Jebba in the north, would also be expanded to handle the increasing demand.

## Joint U.S.S.R.-United States forestry research agreement

Research on ways to control forest fires with chemicals was included in an agreement approved by the Joint U.S.A.-U.S.S.R. Commission on Scientific and Technical Cooperation in Forestry. Other items agreed upon for joint forestry research, at the conclusion of a meeting of foresters from both countries held last October in the United States, concerned integrated control of forest insects and diseases, classification of forest ecosystems and determination of their biological productivity potential, development of improved technological processes of tree harvesting, reforestation and afforestation.

## Southeast Asian timber marketing discussed in the Philippines

Southeast Asia's forest production has expanded rapidly in recent years. By 1973 export earnings from forestry in the region totalled about US$1 000 million, two thirds of which were accounted for by log exports. Last November an international symposium in Manila dealt with ways in which these earnings may be increased in the future.

The meeting, jointly sponsored by the Philippine government, the German Foundation for International Development and FAO, dealt with research and marketing of timber products throughout southeast Asia. Subjects discussed included product development and diversification for local and foreign markets, broadening the raw material base, especially for pulp and paper production, and ways to increase cooperation among countries in the region with wood and wood products industries.

The report of the symposium will be submitted to the FAO Asia-Pacific Forestry Commission.

The week-long meeting was held in Manila and Los Baños, and followed by a four-day tour of forestry in Mindanao. Eighteen participants came from Burma, Indonesia, Malaysia, the Philippines, Singapore and Thailand, and seven observers from Australia, Japan, New Zealand, Papua-New Guinea and the United States. J. de la Rosa, President of the Philippines Chamber of Wood Industries, directed the symposium. He was assisted by H. Grutzner, of the German Foundation for International Development, and T. Erfurth, of FAO. The meeting continued the work of the International Meeting on the Properties, Uses and Marketing of Tropical Timber held in the summer of 1973 at the German Foundation's headquarters in Berlin.

Subjects covered during the symposium included:

— The potential of southeast Asian forest resources for industry and trade development.

— The use properties of southeast Asian timbers.

— Recent experience and research results on improving industrial use and final application of wood and wood products.

— Possibilities for exchanging research results and for coordinating research activities.

— Product development: its multiple impact on national and international trade in and use of products from the tropical moist forests.

— The choice and effective application of promotional measures to advance the wider use of wood products.

— Promoting research and marketing of timbers.

## Sweden's Forest Service to reduce felling

The Swedish Forest Service, which runs the state-owned forests — about one fifth of the country's total forest area — is to reduce the volume of fellings by an average of 1% annually over the five-year period 1975-79. This measure is intended to ameliorate the effects of a drop in timber resources which is expected to occur in about three decades.

Fellings will accordingly decline from the annual average of 6.76 million cubic metres under bark for the years 1970 to 1974 to 6.31 million by 1978/79.

In order to offset the effect of the reduced volume of fellings, the Service will be investing a total of Kr.450 million (US$100 million) in silvicultural measures over the coming five years. This represents a sizable increase over the Kr.172 million spent in the preceding half decade.

Plantings will be increased in 1975-79. A major innovation in the Service's silvicultural programme will be the planting of *Pinus contorta*, a hardy North American pine, in 10% of its forest cultivation area in central and northern Sweden. Tests have shown that this pine gives a good yield after only 40-60 years, growing twice as fast as indigenous pine.

## Minas Gerais in Brazil reforests vast tracts of marginal land

Minas Gerais has assumed the lead in reforestation projects among Brazilian states with a plan to reforest 3.75 million acres (1.5 million hectares) of land by 1980. This figure represents a 280% increase from 1973. There are, all told, some 56 million acres (22 million hectares) of marginal land in Minas Gerais which can be profitably reforested. The state especially needs the timber now as charcoal is the only cheap fuel which can be used to smelt the area's large iron supplies. (*O Globo*, Brazil)

## Forest expansion in east Africa

The United Kingdom's Ministry of Overseas Development has agreed to provide £51 850 toward the cost of a research scheme in Africa aimed at improving the productive capacity of forests in the east African community.

Existing forests in east Africa are insufficient to meet the present demand for timber and wood products, and wood fuel. Expansion, however, on the highly productive land at high altitude where existing forests have already been established, is extremely difficult, given the increasing pressure for agricultural land. This project is therefore aimed at the establishment of tropical pine forests at lower altitudes on less fertile soil.

A tree breeder and a silviculturist have been assigned to east Africa for three years to assist in the establishment of these new forests. Consultancy visits by staff from the Commonwealth Forestry Institute will support them.

**If you are interested in tropical forestry, read**

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## Ibadan-Garoua international symposium on wildlife management

A symposium on wildlife management will be held in Ibadan from 22 to 26 September, jointly organized by the Department of Forest Resources Management of the University of Ibaban, Nigeria, and the Ecole pour la formation de spécialistes de la faune, in Garoua, Cameroon.

The purpose of this symposium is to fill the current gap in research in west and west central Africa, where most of the national parks and game reserves are still in an early stage of development, particularly with regard to research and management.

Most of the work done in east and southern Africa concerns territories which are ecologically different. Wildlife managers and researchers have found that the methods in census taking, in population dynamics and in habitat analysis developed in open rangelands to be of limited application in the savanna woodland of west and central Africa. Moreover, ecologists working in these areas are few and widely dispersed, and have very little contact with one another.

The objectives of the symposium are as follows.

Short-term:

— To gather together relevant information available on wildlife management, with particular reference to west and central Africa.

— To provide an opportunity for direct discussion of wildlife management by field workers and others concerned with this subject.

— To draw attention to the potential and the problems of wildlife management in west and central Africa.

Long-term:

— To determine future needs and priorities in wildlife management research and training in west and central Africa.

— To encourage the exchange of information on wildlife management.

Those interested in participation can obtain further information from either organizer. Contributions on subjects relating to the programme should be submitted to Dr. S.S. Ajayi.

Papers must be in either French or English and must not exceed 3 000 words. There should be a summary not exceeding 300 words.

The organizer's addresses are:

S.S. Ajayi,
Department of Forest Resources Management,
University of Ibadan, Ibadan,
Western State, Nigeria

C. Geerling,
Ecole de Faune, B.P. 271,
Garoua, Cameroon

## Hurricane Fifi's ecological consequences persist

A severe ecological imbalance caused by the passage of Hurricane Fifi through Honduras has brought a plague of insects on that country. The hurricane left numerous pools of still water for the insects to breed in. At the same time it killed thousands of birds and rodents, the insects' natural predators. This unnatural situation forced the government to move in with airborne sprays, raising fears that the final toll of Fifi's damages may include residual poisons in the soil. (*El Universal*, Mexico City)

## More wildlife zones in Thailand

Thailand's Forestry Department is expanding its wildlife conservation zones in an effort to prevent the destruction of wildlife in the country's forests and wilderness.

While previous attempts at conservation, through the creation of forest reserves, had not been successful, because individuals or companies had been allowed to enter them for specific purposes, the establishment of wildlife zones was much more effective as no one was permitted to engage in any type of profit-making activity in the conserved territories.

## Integrated regime for Lake Baikal protection initiated

The Soviet Ministry of Land Reclamation and Water Conservancy has approved "Provisional Rules for the Protection of the Waters of Lake Baikal and the Natural Resources of its Basin." Lake Baikal, called the gem of siberia, lies at the centre of a 75-million-acre (30-million-hectare) area placed under the protection of the Act. A complete ban has been imposed on drift floating of timber on the lake, and riverbeds are being cleared of sunken logs; local purification facilities are being built around the lakeshore, and industries using lake water are instructed to increase recycling. Communal and industrial discharges are prohibited. Certain zones of the lake and rivers flowing into it have been designated salmon and sturgeon spawning grounds: along the banks of these zones, no logging, storage of fertilizers or use of chemical pesticides is permitted. Studies are continuing on what is billed as "the U.S.S.R.'s first experiment in solving the man and nature problem on a large scale." (*Novosti*, Moscow)

## Indian crocodile on brink of extinction

The once plentiful *gharial*, the slender-snouted fish-eating crocodile of India, is now on the brink of extinction and a major effort is required if the species is to survive.

Romulus Whitaker, director of the Madras Snake Park, stated in a report that during a 5 000-kilometre survey in gharial habitat only six wild specimens were seen.

"Killing for its skin is the most important reason for the rapid decline in numbers, and at present fishermen with nets are a very serious threat. The increase in river activity by way of fishing, transport and agriculture has limited the gharial habitat to a very few remaining wild areas. Major alteration of rivers by earthquakes, dams, canal diversions, artificial embankments and increased siltation through erosion are other reasons for the decline. The fact

that we were unable to see more than a few gharial after extensive stays at river stretches described as teeming with crocodilians 40 years ago indicates the rapid change that has taken place.

"Gharial are shot at, netted and prevented from basking in all but the most remote places, and today there are very few spots free from commercial fishing and other river activities."

Mr. Whitaker has recommended that gharial should be captured and moved from dangerous to protected areas; that breeding farms should be established near the original riverine habitat; and that a campaign be launched to publicise the law protecting the gharial.

The gharial, which can grow to over 4 metres, has complete protection under Indian's Wildlife Protection Act 1972, and export of crocodile skins has been banned since 1958.

## The Council of Europe and the environment

A European network of biogenetic reserves, a study on endangered mountain regions and measures to prevent disasters, and a study on problems of renewing plant cover in the Mediterranean region were among the most important activities programmed by 15 delegations of environment officials from member countries of the Council of Europe. They met at the thirteenth session of the Council's European Committee for the Conservation of Nature and Natural Resources, held in Strasbourg from 18 to 21 November 1974.

During the session the Committee reviewed the progress of its work, which included the preparation of general guidelines for international agreements on the protection of natural areas situated at frontiers; a study of the ecological effects of recreation on ecosystems; a study of problems of rational management of recreation areas facing heavy demands; environmental education in pre-primary and primary schools; international courses on applied ecology, particularly the course on management of the natural environment in the Mediterranean region, held in Italy in September 1974.

Future work includes participation in several European environment conferences and ecology courses in 1975 and 1976 and, among its most important projects, a programme for setting up a European network of biogenetic reserves. This activity is closely connected with MAB-8, that is, the international network of biosphere reserves. Another activity is study of endangered mountain regions and disaster prevention measures. The Committee aims to establish an Alpine Charter, or convention for the alpine countries. Still another project is a study of problems of renewing plant cover in the Mediterranean region. It was proposed to set up an *ad hoc* group with the participation of other Mediterranean countries not members of the Council of Europe.

## Proceedings of the Second World Conference on National Parks

The complete record of the Second World Conference on National Parks, held in September 1972 at the Yellowstone and Grand Teton National Parks in the United States, has been published by the International Union for Conservation of Nature and Natural Resources (IUCN). It contains all the 32 background papers, prepared by experts from all over the world, and full reports on the discussions and actions taken at each of the 17 technical sessions at Grand Teton and the final recommendations of the Conference. A summary of the Yellowstone portion of the Centennial Celebration is included. Appendix information includes the names and addresses of all participants. The editor is Sir Hugh Elliott. The book is published in three separate language editions and may be ordered for US$10 from: The International Union for Conservation of Nature and Natural Resources - 1110 Morges, Switzerland.

## Halting the Rajasthan desert

In northern India the Haryana Forest Department has achieved a breakthrough in its herculean task of halting the march of the desert from neighbouring Rajasthan which threatened to engulf fertile fields, the irrigation system and communications network in its border districts.

According to the Chief Conservator of Forests, Mr. R.S. Sahrawat, over 40 000 hectares of land, most of it agricultural, had been shielded against the menace by raising shelter belts along the border and in gaps, stabilizing the existing sand dunes and raising windbreaks in an area of 4 700 hectares.

Mr. Sahrawat said that the yield in the protected areas was expected to double in a few years.

He added that geologists believe that desert conditions, which were not so serious in the past, had been caused by an extreme degree of aridity combined with the sand-drifting action of sweeping southwestern winds. The destruction of vegetative cover, caused by the heavy incidence of biotic factors and irrational use of land, exposed the sand to the wind.

He said that "operation desert halt" was being executed under difficult and inhospitable conditions. The tract was subjected to extremes of climate. During summer the temperature rose to 47°C, falling to 1°C during winter. Rainfall in the area was scanty and distributed over a short period. The problem of grazing was aggravated by nomads from Rajasthan who visited the area with large herds of cattle.

Mr. Sahrawat said that the desert control programme was incomplete without the treatment of cultivated lands. To achieve this, windbreaks had been raised along the periphery of cultivated fields to reduce wind velocity and create favourable microclimatic influences. This step had also helped in protecting the fields from chilly winds during winter. (*Times of India*, New Delhi)

## Whooping cranes, gene banks and fast turkeys

The Patuxent Wildlife Research Centre near Laurel, Maryland, in the United States, functions as a gene bank for endangered species. Recently, 13 whooping crane eggs gathered from nests in Canada's Buffalo National Park by Canadian and United States Wildlife Service biologists were flown by jet to the Centre, in an effort to save the cranes from extinction. Whoopers are kept there to produce stock for release in the wild, where only about 48 birds are currently surviving.

Of the 13 arrivals, nine hatched in incubators and four of these survived. The hatchlings increased the captive whooper flock to 21. Whoopers of both sexes are combative from the beginning. Captive chicks at Patuxent pick fights as soon as they can stand, but in the Centre's pen they don't have to fight each other. Turkey chicks have been introduced to divert a whooper from fighting a brother or sister. Turkeys can outrun the cranes, so after a while they all tire from the chase and everyone benefits from the exercise.

Dr. Ray C. Erickson heads the whooper programme at Patuxent.

# BOOKS AND REPORTS

## BRITISH FORESTRY: A PROGRESS REPORT

The progress of forestry in the United Kingdom is presented in *British Forestry*, a new reference book from the Forestry Commission. It includes a detailed study of the latest policy decisions, announced in July 1974, designed to ensure that British forestry forms part of an effective pattern of land use in harmony with agriculture. It explains the new grant-aid scheme for private forestry and shows through tables that Britain expects to cover 11 percent of its total timber needs by the turn of the century — a jump of 3 percent over current output. This increase in production will promote new industries, many in areas of high unemployment.

Although home-grown timber's main use has been for fencing and pitprops, in future years the bulk will go to pulp mills and chipboard factories. Details of these industrial trends are given in the book, which also discusses the policy designed to develop the recreational potential of Britain's forests through planning and management of recreation.

*British Forestry* (50 pages, 21 maps and diagrams, 83 colour and 16 black and white prints, price £1.00) is available from the Forestry Commission, 25 Savile Row, London W.1, or from the Forest Office, Blairadam, Kelty, Fife, Scotland.

## TREE SEEDS AND TREE SEED WORKERS

Tree seeds, as well as tree seed workers, are being thoroughly classified in the United States and Canada.

The first reference book on seeds of United States trees and shrubs to be issued in more than a quarter century by the U.S. Department of Agriculture was released in January. *Seeds of woody plants in the United States* is the culmination of five years of effort by more than 100 scientists at Forest Service research laboratories and special project locations throughout the country, assisted by an equal number of scientists and researchers from universities, private seed-testing laboratories and companies, state agencies and other federal government departments.

The handbook contains two sections. The first gives general methods for producing, handling and germinating seeds. The second provides data and information on species, alphabetically listed by genus units, giving scientific and common names, flowering and fruiting dates, methods off-ruit collection, seed extraction, storage and other data useful for grower and marketer.

The volume includes a cllection of drawings and photographs for checking the identification of fruits, seeds or seedlings.

*Seeds of woody plants in the United States* (Agriculture Handbook No. 450) is for sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. The price is $13.60.

From Canada comes the announcement that a computerized World Directory of Tree Seed Workers is being compiled by Dr. D.G.W. Edwards, Canadian Forestry Service, Victoria, B.C., Canada, on behalf of the International Union of Forest Research Organizations (IUFRO) Working Party S2.01.06 (Seed Problems).

The Directory will include all aspects of seed ontogeny, origin, technology and health, and will supersede that recently published by Simak. In addition to being a source of addresses and a mailing list for meetings, it will serve as a register of manpower and of experts to advise on or investigate specific tree seed problems.

The directory, which will be updated periodically, will list all tree seed workers, whether they are involved at the research or industrial-operational levels, in all countries of the world.

## BUILDING TECHNOLOGY

A 70-page booklet, *Roofing in Developing Countries: Research for New Technologies*, in English, with summaries in French and Spanish, has been issued by the National Academy of Sciences, National Research Council, Washington, D.C., United States.

## A NEW NEWSLETTER

*Scandinavian Forest Economics*, a newsletter in English, was begun in 1974 by the Nordic Forest Economics Seminar and published by Postipankii, Helsinki.

Two issues received in 1974 contained a variety of news items and short articles on forestry, forestry education and research in that part of the world. Forestry in developing countries in also covered.

For further information contact the editor, Michael Jones, Department of Land Reallocation and Consolidation, Agricultural University of Norway, N-1432 As-NLH, Norway.

## PAPER MILL DIRECTORY

*Deutsche Papiersorten* is the first data-processed directory of paper and board mills in the Federal Republic of Germany, listing 280 paper-making firms and details of their production. Listings are in German with titles and introduction in German and French. Published by Verlag Winter & Co., Breslauer Strasse 5, Heusenstamm D-6056; price DM20, plus postage.

## FROM AMSTERDAM

The Royal Institute of Amsterdam, Department of Agricultural Research, has published its first experimental issue of *Abstracts on Tropical Agriculture*, to appear monthly as of 1 January 1975, containing indexed information from world literature on tropical and subtropical agriculture and composed by computer processing (English).

The Department's Wood Section has issued a 34-page booklet, *Notes on the Marketing of Tropical Timber* by J.T. Wassing. It is a compact "compilation of research results and experience gained in the field of promotion of species not yet accepted on the timber market." The booklet is in English, with short summaries in French, Italian and Spanish.

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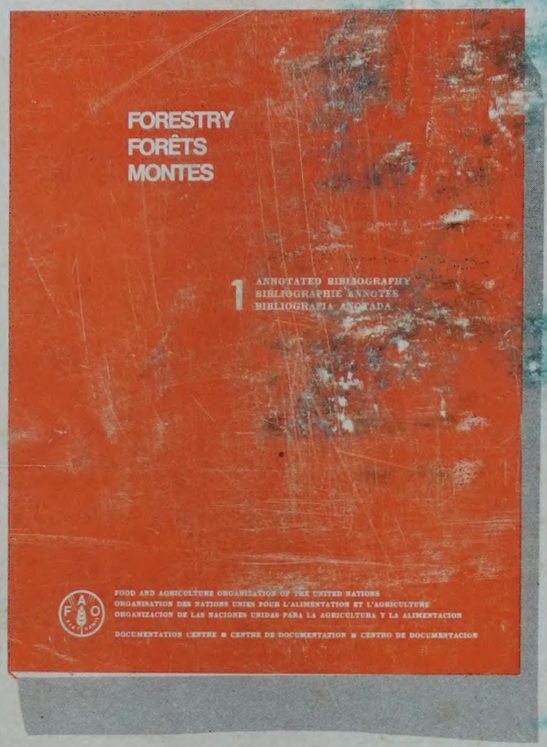


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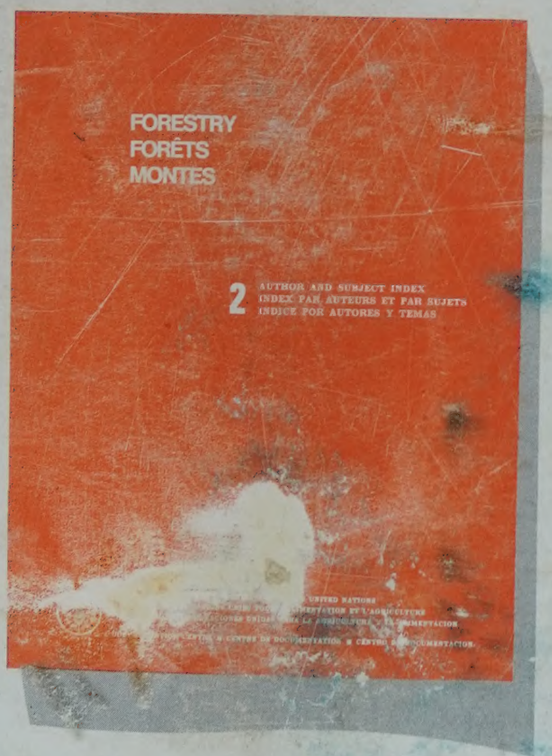


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